

BIOLOGY SEQUENCING

Preparation
For
Keystone & Life
Long Learning

The Assessment Anchors and Eligible Content statements were created by other groups of educators charged with the task of clarifying the standards assessed on the Keystone Exams. The Assessment Anchors, as defined by the Eligible Content, have been designed to hold together or anchor the state assessment system and curriculum/instructional practices in West Philadelphia HS.

Assessment Anchors, as defined by the Eligible Content, were created with the following design parameters:

- Clear: The Assessment Anchors are easy to read and are user friendly; they clearly detail which standards are assessed on the Keystone Exams.
- Focused: The Assessment Anchors identify a core set of standards that could be reasonably assessed on a large-scale assessment, which will keep educators from having to guess which standards are critical.
- Rigorous: The Assessment Anchors support the rigor of the state standards by assessing higher order and reasoning skills.
- Manageable: The Assessment Anchors define the standards in a way that can be easily incorporated into a course to prepare students for success.

How can West Philadelphia HS science teachers, use these Assessment Anchors?

The Assessment Anchors, as defined by the Eligible Content, can help focus teaching and learning because they are clear, manageable, and closely aligned with the Keystone Exams. Teachers will be better informed about which standards will be assessed. The Assessment Anchors and Eligible Content should be used along with the Standards and the Curriculum Framework of the Standards Aligned System (SAS) to build curriculum, design lessons, and support student achievement. The Assessment Anchors and Eligible Content are designed to enable educators to determine when they feel students are prepared to be successful on the Keystone Exams. An evaluation of current course offerings, through the lens of what is assessed on those particular Keystone Exams, may provide an opportunity for an alignment to ensure student preparedness.

SCIENTIFIC METHOD / NATURE OF SCIENCE

Biology: *The scientific study of life.*

Embryology: *The branch of zoology studying the early development of living things.*

Forensics: *The science of tests and techniques used during the investigation of crimes.*

Hypothesis: *A proposed, scientifically testable explanation for an observed phenomenon.*

Law (Scientific): *A law that generalizes a body of observations. At the time it is made, no exceptions have been found to a law. It explains things but does not describe them; serves as the basis of scientific principles.*

Mechanism (Scientific): *The combination of components and processes that serve a common function.*

Principle (Scientific): *A concept based on scientific laws and axioms (rules assumed to be present, true, and valid) where general agreement is present.*

Science: *A body of evidence-based knowledge gained through observation and experimentation related to the natural world and technology.*

Theory (Scientific): *An explanation of observable phenomena based on available empirical data and guided by a system of logic that includes scientific laws; provides a system of assumptions, accepted principles, and rules of procedure devised to analyze, predict, or otherwise explain the nature or behavior of a specific set of phenomena.*

MODULE A:

CELLS AND

CELL

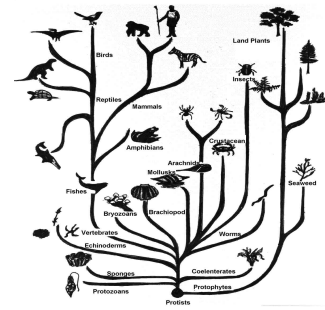
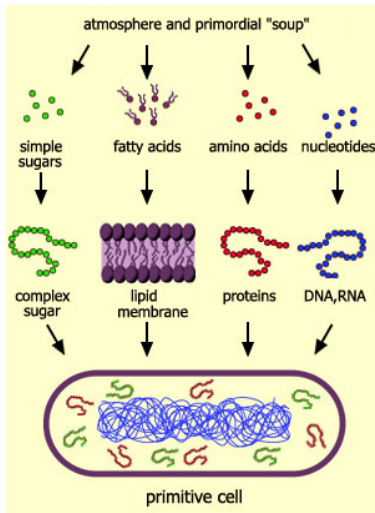
PROCESSES



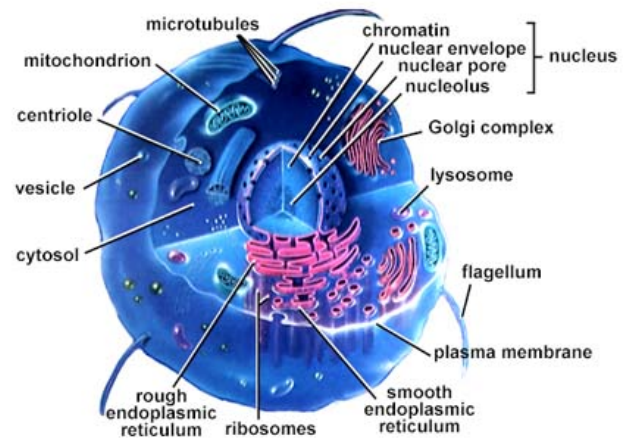
BIG Ideas in Module A



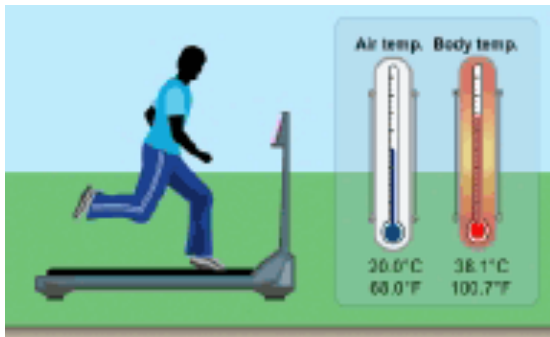
#1: Organisms share *common* characteristics of life.



#2: Life emerges due to the chemical organization of matter into **cells**.

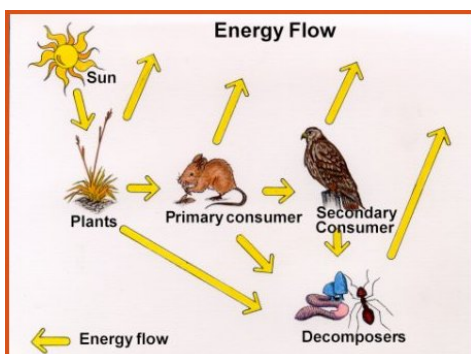
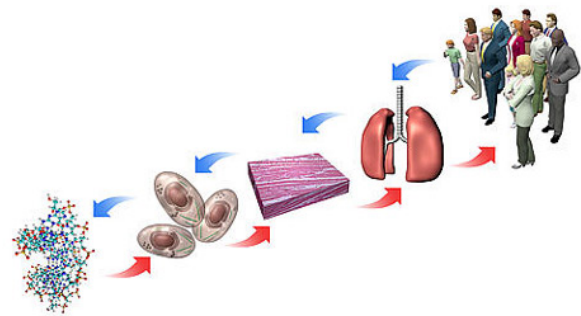


#3: **Cells** are the basic unit of structure and function for all organisms.



#4: Through a variety of mechanisms organisms seek to maintain a biological balance between their internal and external environments (**homeostasis**).

#5: Eukaryotic cells can **differentiate** and organize making it possible for multicellularity.



#6: Organisms obtain and use *energy* to carry out their life processes.

UNIT 1: BASIC BIOLOGICAL PRINCIPLES

ASSESSMENT ANCHOR BIO.A.1 Basic Biological Principles		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.A.1.1 Explain the characteristics common to all organisms.	BIO.A.1.1.1 Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.	3.1.B.A1 3.1.B.C2 4.1.3.A 4.1.4.A

Sample Exam Question

Standard BIO.A.1.1.1

Which characteristic is shared by all prokaryotes and eukaryotes?

- A. ability to store hereditary information
- B. use of organelles to control cell processes
- C. use of cellular respiration for energy release
- D. ability to move in response to environmental stimuli

ASSESSMENT ANCHOR BIO.A.1 Basic Biological Principles (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.A.1.2 Describe relationships between structure and function at biological levels of organization.	BIO.A.1.2.1 Compare cellular structures and their functions in prokaryotic and eukaryotic cells.	3.1.B.A1 3.1.B.A5 3.1.B.C2 4.1.4.A

Sample Exam Question

Standard BIO.A.1.2.1

Living organisms can be classified as prokaryotes or eukaryotes. Which two structures are common to both prokaryotic and eukaryotic cells?

- A. cell wall and nucleus
- B. cell wall and chloroplast
- C. plasma membrane and nucleus
- D. plasma membrane and cytoplasm

ASSESSMENT ANCHOR		
BIO.A.1 Basic Biological Principles (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.A.1.2 Describe relationships between structure and function at biological levels of organization.	BIO.A.1.2.1 Compare cellular structures and their functions in prokaryotic and eukaryotic cells.	3.1.B.A1 3.1.B.A5 3.1.B.C2 4.1.4.A

Sample Exam Question

Standard **BIO.A.1.2.1**

Prokaryotic cells are generally much smaller than eukaryotic cells.

Part A: Identify a structural difference between prokaryotic cells and eukaryotic cells that is directly related to their difference in size.

Part B: Based on the structural difference, explain why prokaryotic cells can be much smaller than eukaryotic cells.

Part C: Describe one similarity between prokaryotic cells and eukaryotic cells that is independent of size.

ASSESSMENT ANCHOR		
BIO.A.1 Basic Biological Principles (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.A.1.2 Describe relationships between structure and function at biological levels of organization.	BIO.A.1.2.2 Describe and interpret relationships between structure and function at various levels of biological organization (i.e., organelles, cells, tissues, organs, organ systems, and multicellular organisms).	3.1.B.A5 3.1.B.A6 3.1.B.A1

Sample Exam Question

Standard BIO.A.1.2.2

Alveoli are microscopic air sacs in the lungs of mammals. Which statement **best** describes how the structure of the alveoli allows the lungs to function properly?

- A. They increase the amount of energy transferred from the lungs to the blood.
- B. They increase the flexibility of the lungs as they expand during inhalation.
- C. They increase the volume of the lungs, allowing more oxygen to be inhaled.
- D. They increase the surface area of the lungs, allowing efficient gas exchange.



LESSON 1 UNIFYING CHARACTERISTICS OF LIFE PAGE 7 – 14
 LESSON 2 ORGANIZATION OF MULTICELLULAR ORGANISMS PAGE 15 – 24

Cells and the Organization of Life

Introduction

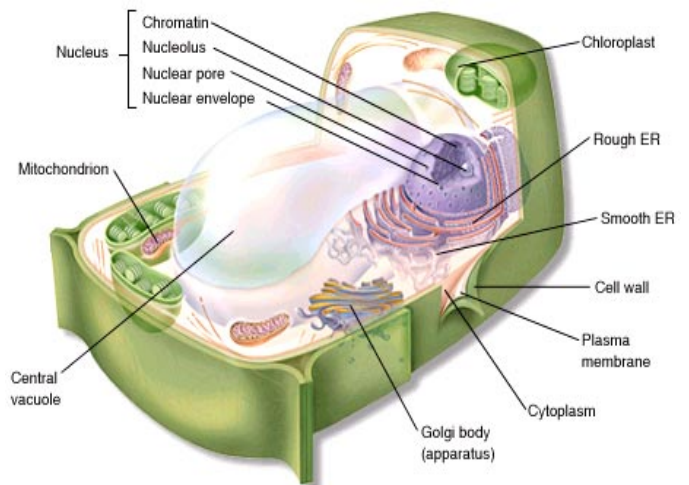
Eukaryotic cells are larger and more complex than prokaryotic cells. They include many organelles, membrane-bound structures with specialized functions. This generalized animal cell shows the prominent nucleus, extensive membrane system of the endoplasmic reticulum, mitochondria, other organelles and numerous ribosomes.

- **Eukaryotic Cells** - Cell that possesses a nucleus and the other membranous organelles characteristic of complex cells.
- **Prokaryotic Cells** - Cell lacking a nucleus and the membranous organelles found in complex cells; bacteria, including cyanobacteria.
- **Organelles** - Specialized structure within cells (e.g., nucleus, mitochondria, and endoplasmic reticulum).
- **Nucleus** - I. The distinctive organelle of a eucaryotic cell, consisting of a membranous envelope in which the chromosomes reside; II. a cluster of neuron cell bodies within the central nervous system; III. the central body of an atom, made of protons and, usually, neutrons.
- **Endoplasmic Reticulum** - Membranous system of tubules, vesicles, and sacs in cells, sometimes having attached ribosomes. Rough ER has ribosomes; smooth ER does not.
- **Mitochondria** - Membranous organelle in which aerobic cellular respiration produces the energy carrier ATP.
- **Ribosomes** - Minute particle that is attached to endoplasmic reticulum or occurs loose in the cytoplasm and is the site of protein synthesis.

Plant Cells

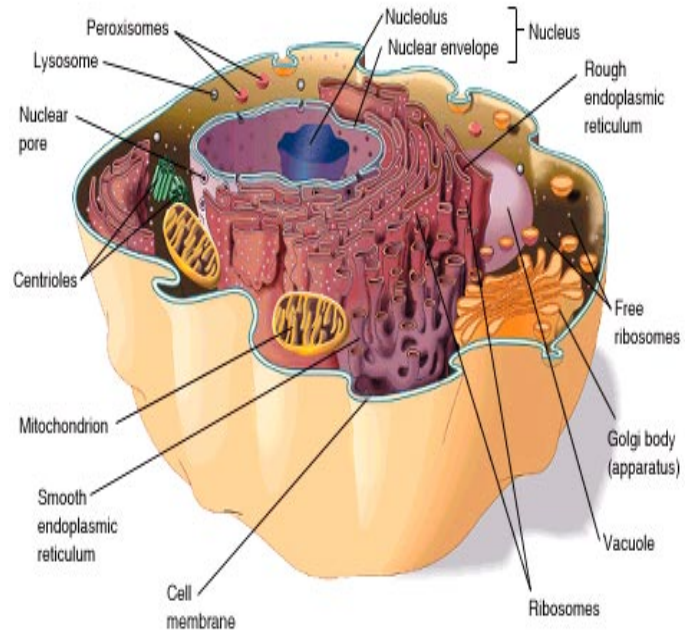
This plant cell has some structures not found in animal cells. These include a cell wall outside of the plasma membrane, a large central vacuole, and chloroplasts.

- **Cell Wall** - Protective barrier outside the plasma membrane of plant and certain other cells.
- **Plasma Membrane** - Membrane surrounding the cytoplasm that consists of a phospholipid bilayer with embedded proteins; functions to regulate the entrance and exit of molecules from cell.
- **Vacuole** - Membranous cavity, usually filled with fluid.
- **Chloroplasts** - Membranous organelle that contains chlorophyll and is the site of photosynthesis.




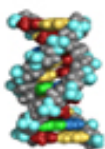

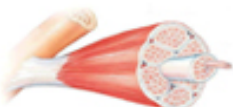



Animal Cell Review

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- **Ribosomes** - Minute particle that is attached to endoplasmic reticulum or occurs loose in the cytoplasm and is the site of protein synthesis.
- **Golgi apparatus** – Stacked set of membranes that modifies, transports, and packages materials for export



Organization of Life

Life is organized in ways from the simplest to the complex. At the multicellular level, specialized cells develop in such a manner where they structure (shape) helps them better perform a specific function (their job).

Level of Organization	Explanation	Example
 Atomic Level	Atoms are defined as the smallest unit of an element that still maintains the property of that element.	Carbon, Hydrogen, Oxygen
 Molecular Level	Atoms combine to form molecules which can have entirely different properties than the atoms they contain.	Water, DNA, Carbohydrates
 Cellular Level	Cells are the smallest unit of life. Cells are enclosed by a membrane or cell wall and in multicellular organisms often perform specific functions.	Muscle cell, Skin cell, Neuron
 Tissue Level	Tissues are groups of cells with similar functions	Muscle, Epithelial, Connective
 Organ Level	Organs are two or more types of tissues that work together to complete a specific task.	Heart, Liver, Stomach
 Organ System Level	An organ system is group of organs that carries out more generalized set of functions.	Digestive System, Circulatory System
 Organismal Level	An organism has several organ systems that function together.	Human

STRUCTURE (AND FUNCTION) GLOSSARY

Analogous Structure: *A physical structure, present in multiple species, that is similar in function but different in form and inheritance.*

Homologous Structure: *A physical characteristic in different organisms that is similar because it was inherited from a common ancestor.*

Organ: *An anatomical unit composed of tissues serving a common function.*

Organ System: *An anatomical system composed of a group of organs that work together to perform a specific function or task.*

Organism: *A form of life; an animal, plant, fungus, protist or bacterium.*

Tissue: *An anatomical unit composed of cells organized to perform a similar function.*

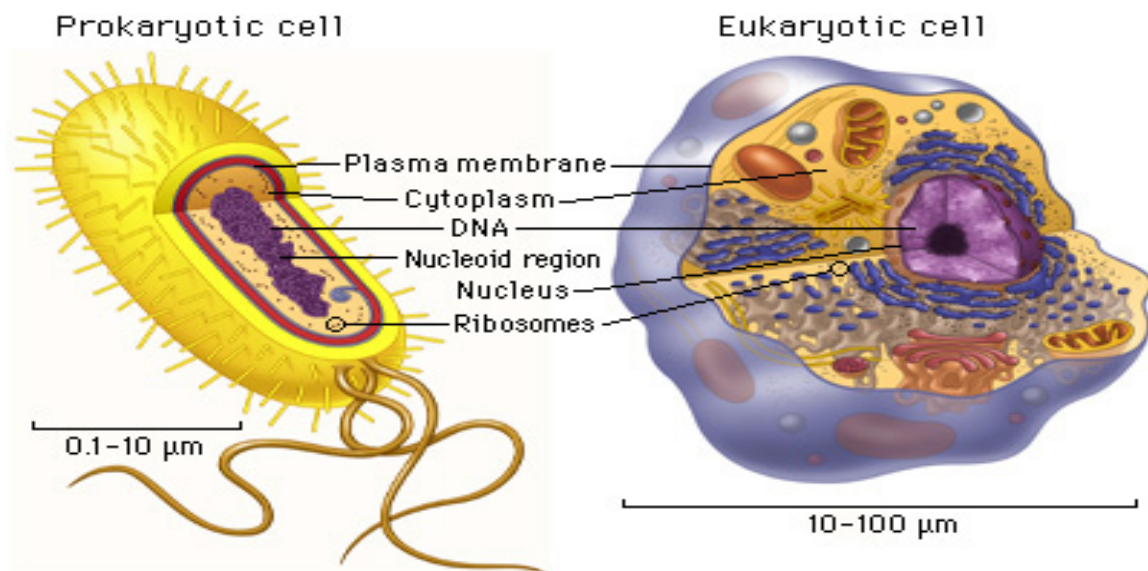
Vestigial Structure: *A physical characteristic in organisms that appears to have lost its original function as a species has changed over time.*

Cells and Cellular Organization

Please use the link below to guide you

<https://www.youtube.com/watch?v=Hmwvj9X4GNY>

1. What structure defines a cell? _____
2. What do we call an organism that does have a nucleus? _____
What do we call an organism that does not have a nucleus? _____
3. What are two examples of prokaryotes? _____
4. What are three types of eukaryotes? _____
5. Ribosomes help to make _____ for the cell
6. The fluid in the cells is called the _____ (aka cytoplasm)
7. The Endoplasmic reticulum connects to the _____ Bodies
8. The section of the Endoplasmic Reticulum with attached ribosomes is called the _____ ER
The section of the Endoplasmic Reticulum without ribosomes is called the _____ ER
9. When a protein leaves the Golgi Bodies, what does it take with it? _____
This piece will help it float around in the cell and fuse with the cell membrane.
10. What items could be stored in a vesicle? _____
11. Lysosomes and lytic vacuoles do what? _____
12. What is an organelle? _____
13. Where do we turn sugars into ATP? _____
14. What do plants use for photosynthesis? _____
15. What do filaments do? _____



Keystone Pre-Test

The questions in this quiz refer to: Cells

1. Which type of cell has a nucleus? (Prokaryote; Eukaryote; Both; Neither)
2. The structure found in ALL cells that encloses a cell from the outside is the _____.
(Cytosol; Cell wall; Endoplasmic Reticulum; Cell membrane)
3. Plants have this structure that allows them to carry out photosynthesis
(Mitochondria; Golgi Bodies; Chloroplasts; Chromosomes)
4. Due to having less items in the cell, _____ are usually smaller
(Prokaryotes; Eukaryotes; Both; Neither)
5. Where are ribosomes made? (Nucleus; Nucleolus; Cytosol; Rough endoplasmic reticulum)
6. Golgi Bodies are connected to which structure?
(Endoplasmic Reticulum; Cell wall; Mitochondria; Nucleus)
7. An organelle must be...
(surrounded by a membrane; able to leave a cell; made up of carbohydrates; contain DNA)
8. The function of the nucleus is to
(make the cell bigger; make proteins; surround and protect the cell; surround and protect DNA)
9. Which of the following correctly matches a cell part with its function
(mitochondria...photosynthesis; nucleus...make ATP; vesicle/vacuole...storage; lysosome...movement)
10. Some cells have a rigid _____ outside of the membrane for even more support.
(cell wall; cytoskeleton; filament; Golgi Body)

CELL STRUCTURE GLOSSARY

- Cell:** *The basic unit of structure and function for all living organisms. Cells have three common components: genetic material, cytoplasm, and a cell membrane. Eukaryotic cells also contain specialized organelles.*
- Chloroplast:** *An organelle found in plant cells and the cells of other eukaryotic photosynthetic organisms where photosynthesis occurs.*
- Endocytosis:** *A process in which a cell engulfs extracellular material through an inward folding of of its plasma membrane.*
- Endoplasmic Reticulum (ER):** *An organelle, containing folded membranes of sacs, responsible for the production, processing, and transportation of materials for use inside and outside a eukaryotic cell. There are two forms of this organelle: rough ER that has surface ribosomes and participates in the synthesis of proteins mostly destined for export by the cell and smooth ER that has no ribosomes and participates in the synthesis of lipids and steroids as well as the transport of synthesized macromolecules.*
- Endosymbiosis:** *A theorized process in which early eukaryotic cells were formed from simpler prokaryotes.*
- Eukaryote:** *A type of organism composed of one or more cells containing a membrane-bound nucleus specialized organelles in the cytoplasm, and a mitotic nuclear division cycle.*
- Extracellular:** *Located outside a cell.*
- Golgi Apparatus:** *An organelle found in eukaryotic cells responsible for the final stages of processing proteins for release by the cell.*
- Mitochondrion:** *A membrane-bound organelle found in most eukaryotic cells; site of cellular respiration.*
- Multicellular:** *Made up of more than one cell.*
- Nucleus:** *A membrane-bound organelle in eukaryotic cells functioning to maintain the integrity of the genetic material and, through the expression of that material, controlling and regulating Cellular activities.*
- Organelle:** *A subunit within a cell that has a specialized function.*
- Plastids:** *a group of membrane-bound organelles commonly found in photosynthetic organisms and mainly responsible for the synthesis and storage of food.*
- Prokaryote:** *A single-celled organism that lacks a membrane-bound nucleus and specialized organelles.*
- Ribosome:** *A cellular structure composed of RNA and proteins that is the site of protein synthesis in eukaryotic and prokaryotic cells.*
- Unicellular:** *Made up of a single cell.*

UNIT 2: THE CHEMICAL BASIS OF LIFE

ASSESSMENT ANCHOR BIO.A.2 The Chemical Basis for Life		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.A.2.1 Describe how the unique properties of water support life on Earth.	BIO.A.2.1.1 Describe the unique properties of water and how these properties support life on Earth (e.g., freezing point, high specific heat, cohesion).	3.1.B.A8 3.1.B.A5 4.2.5.C

Sample Exam Question

Standard BIO.A.2.1.1

Which statement **best** describes an effect of the low density of frozen water in a lake?

- A. When water freezes, it contracts, decreasing the water level in a lake.
- B. Water in a lake freezes from the bottom up, killing most aquatic organisms.
- C. When water in a lake freezes, it floats, providing insulation for organisms below.
- D. Water removes thermal energy from the land around a lake, causing the lake to freeze.

ASSESSMENT ANCHOR BIO.A.2 The Chemical Basis for Life (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.A.2.2 Describe and interpret relationships between structure and function at various levels of biochemical organization (i.e., atoms, molecules, and macromolecules).	BIO.A.2.2.1 Explain how carbon is uniquely suited to form biological macromolecules.	3.1.B.A7 3.2.C.A2
	BIO.A.2.2.2 Describe how biological macromolecules form from monomers.	3.1.B.A7 3.1.B.A8 3.1.B.A2 3.1.C.A2 3.1.C.A7

Sample Exam Questions

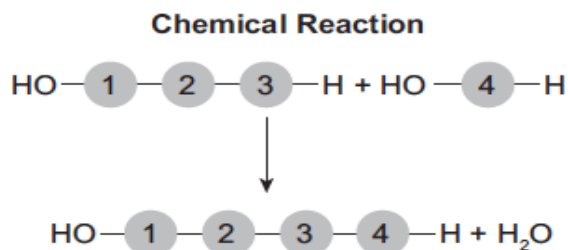
Standard BIO.A.2.2.1

Which statement correctly describes how carbon's ability to form four bonds makes it uniquely suited to form macromolecules?

- A. It forms short, simple carbon chains.
- B. It forms large, complex, diverse molecules.
- C. It forms covalent bonds with other carbon atoms.
- D. It forms covalent bonds that can exist in a single plane.

Standard BIO.A.2.2.2

Use the diagram below to answer the question.



The diagram shows a reaction that forms a polymer from two monomers. What is this type of reaction called?

- A. glycolysis
- B. hydrolysis
- C. photosynthesis
- D. dehydration synthesis

ASSESSMENT ANCHOR BIO.A.2 The Chemical Basis for Life (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.A.2.2 Describe and interpret relationships between structure and function at various levels of biochemical organization (i.e., atoms, molecules, and macromolecules).	BIO.A.2.2.3 Compare the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.	3.1.B.A7 3.1.B.A2 3.1.C.A2 3.1.C.A7

Sample Exam Question

Standard BIO.A.2.2.3

Carbohydrates and proteins are two types of macromolecules. Which functional characteristic of proteins distinguishes them from carbohydrates?

- A. large amount of stored information
- B. ability to catalyze biochemical reactions
- C. efficient storage of usable chemical energy
- D. tendency to make cell membranes hydrophobic

ASSESSMENT ANCHOR BIO.A.2 The Chemical Basis for Life (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.A.2.2 Describe and interpret relationships between structure and function at various levels of biochemical organization (i.e., atoms, molecules, and macromolecules).	BIO.A.2.2.3 Compare the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.	3.1.B.A7 3.1.B.A2 3.1.C.A2 3.1.C.A7

Sample Exam Question

Standard BIO.A.2.2.3

Proteins are a major part of every living cell and have many different functions within each cell. Carbohydrates also perform numerous roles in living things.

Part A: Describe the general composition of a protein molecule.

Part B: Describe how the structures of proteins differ from the structures of carbohydrates.

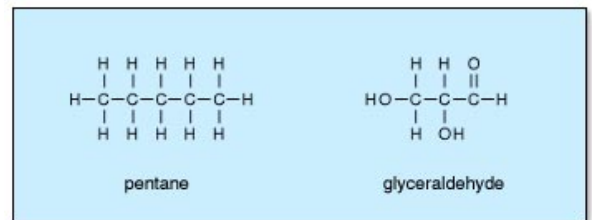
Part C: Describe how the functions of proteins differ from the functions of carbohydrates.

Biochemistry and the Molecules of Life

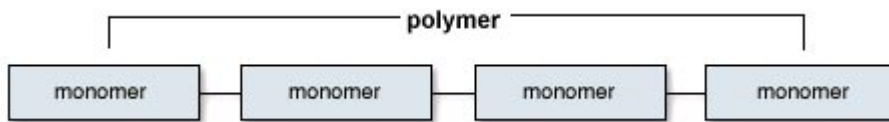
Organic Compounds

Most of the molecules in living things are organic molecules, meaning that they contain carbon. The fact that carbon has 4 electrons in its outermost shell means that it is capable of covalently bonding with other atoms to fill its outermost shell. Organic molecules typically involve carbon bonded to hydrogen, oxygen, nitrogen and other carbon atoms. Carbon atoms bonded to each other form long chains to which atoms or groups of atoms can be attached.

- **Organic Molecules** - Molecule that always contains carbon (C) and hydrogen (H); organic molecules are associated with living things.
- **Electrons** - Subatomic particle that has almost no weight and carries a negative charge; orbits in a shell about the nucleus of an atom.
- **Covalently Bonding** - Chemical bond between atoms that results from the sharing of a pair of electrons.



Polymer Synthesis

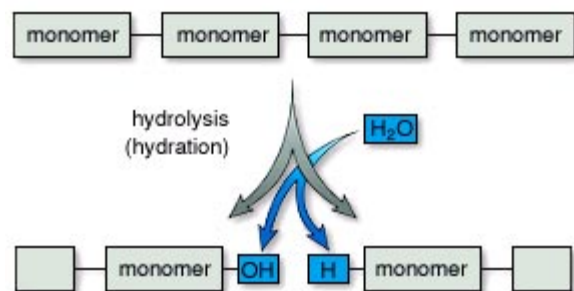
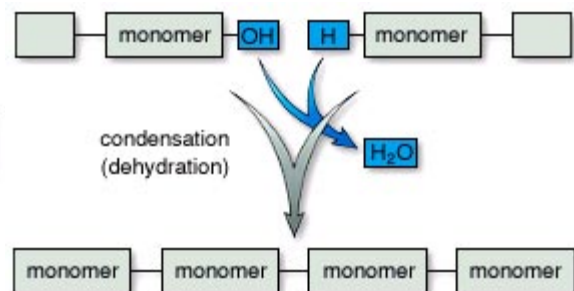


Many organic molecules consist of subunits, called monomers, that are joined together to form what are referred to as polymers.

- **Monomers** - One of the similar or identical molecules of which a polymer is made.
- **Polymers** - A macromolecule made by joining many similar or identical molecules [monomers] through similar or identical bonds.

Monomers are joined together by **condensation (or dehydration) reactions**, which form water molecules in the process. Polymers can also be broken into monomers by hydrolysis reactions, which use water molecules in the process.

Polymers are broken down by **Hydrolysis**, which is the splitting of a covalent bond by the addition of water.

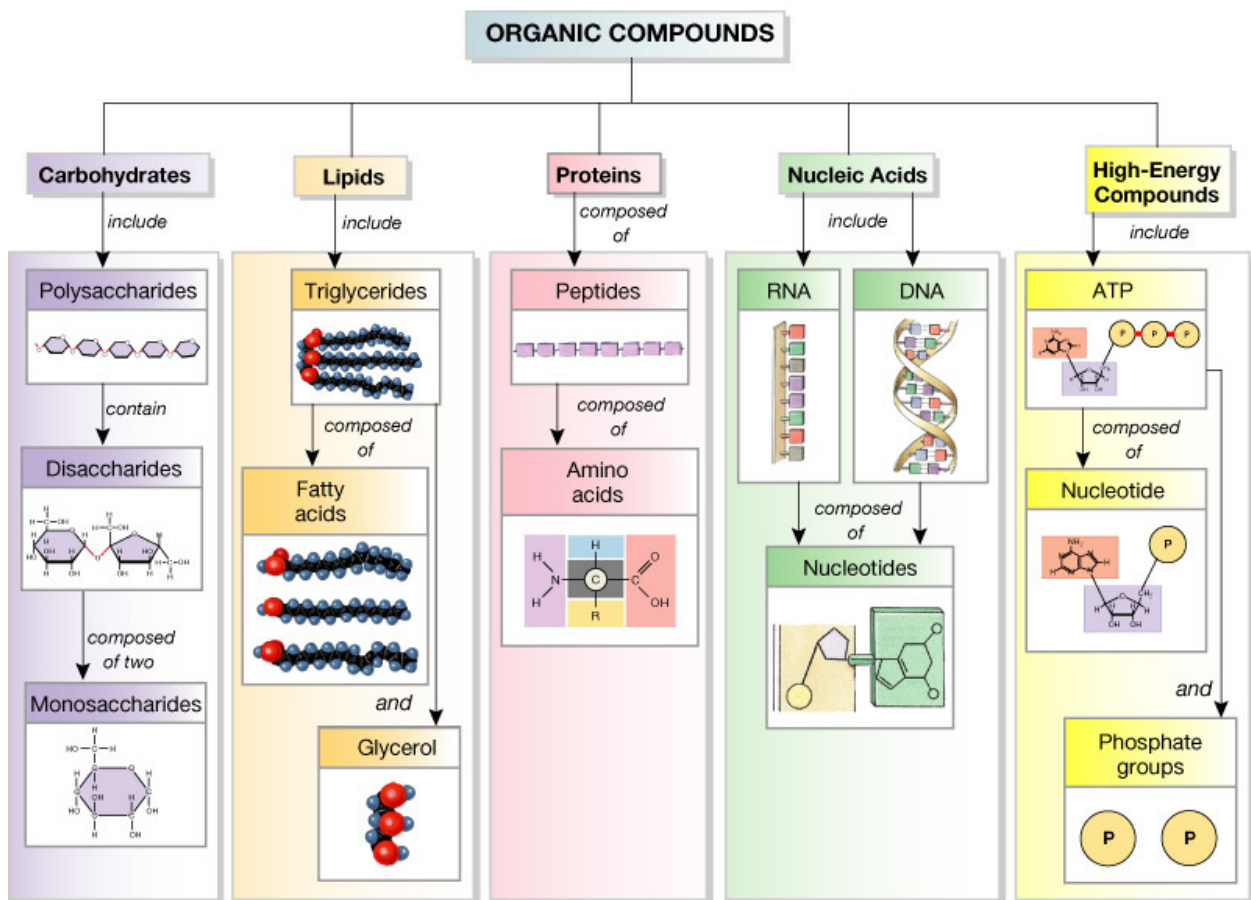


Four Kinds of Organic Molecules

There are 4 major kinds of organic molecules, carbohydrates, lipids, proteins and nucleic acids. Each of these exists as a polymer, composed of the monomers shown in the table.

- **Carbohydrates** - Organic compound characterized by the presence of CH_2O groups; includes monosaccharides, disaccharides, and polysaccharides; quick energy for the cell
- **Lipids** - Organic compound that is insoluble in water; notably fats, oils, and steroids; contain C,H and a little O.
- **Proteins** - Organic compound that is composed of either one or several polypeptides; used for structure, hormones, or enzymes; contain C,H,O,N, and sometimes S
- **Nucleic Acids** - A polymer of nucleotides; contains the genetic information/code of the cell

Polymer	Monomer
polysaccharide (carbohydrates)	monosaccharide (carbohydrates)
lipid (e.g., fat)	glycerol and fatty acid
protein	amino acid
nucleic acid	nucleotide



Biochemistry and the Molecules of Life

Please use the link below to guide you

<https://docs.google.com/file/d/0By3MFJ-zJlsYekRhRWxXSG01Z2M/edit>

1. What does it mean for a compound to be organic?
2. Water is (circle one) **polar** / **nonpolar** because the electrons are not evenly shared.
3. What two properties of water are mentioned?
 - a.
 - b.
4. What is the difference between a monomer and polymer?
5. Dehydration synthesis _____ water to _____ a bond, while hydrolysis _____ water to _____ a bond.
6. Carbohydrates have a ___: ___: ___ ratio of the elements C:H:O. Carbohydrates are the main _____ source for a cell.
7. What are the two monomers of lipids?
 - a.
 - b.
8. Lipids make up the majority of the cell _____.
9. Nucleic acids have the following elements: _____. Nucleic acids store our _____.
10. Amino acids (the monomers of a protein) are made up of what three parts?
 - a.
 - b.
 - c.
11. How do enzymes act as biological catalysts?

Macromolecule	Elements	Monomer and polymer	Roles
<u>Carbohydrates</u>	CHO	Monosaccharide/ polysaccharide	Quick/main source of energy
<u>Lipids</u>	CH and a little O	Glycerol and fatty acid/lipid	Long-term source of energy; cell membrane
<u>Nucleic acids</u>	CHOPN	Nucleotide / nucleic acid	Genetic material
<u>Proteins</u>	CHOSN	Amino acid / polypeptide or protein	Structure and enzymes

ASSESSMENT ANCHOR BIO.A.2 The Chemical Basis for Life (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.A.2.3 Explain how enzymes regulate biochemical reactions within a cell.	BIO.A.2.3.1 Describe the role of an enzyme as a catalyst in regulating a specific biochemical reaction.	3.1.B.A2 3.1.B.A7
	BIO.A.2.3.2 Explain how factors such as pH, temperature, and concentration levels can affect enzyme function.	3.1.B.A2 3.1.B.A7

Sample Exam Questions

Standard BIO.A.2.3.1

Substance A is converted to substance B in a metabolic reaction. Which statement **best** describes the role of an enzyme during this reaction?

- A. It adjusts the pH of the reaction medium.
- B. It provides energy to carry out the reaction.
- C. It dissolves substance A in the reaction medium.
- D. It speeds up the reaction without being consumed.

Standard BIO.A.2.3.2

A scientist observes that, when the pH of the environment surrounding an enzyme is changed, the rate the enzyme catalyzes a reaction greatly decreases. Which statement **best** describes how a change in pH can affect an enzyme?

- A. A pH change can cause the enzyme to change its shape.
- B. A pH change can remove energy necessary to activate an enzyme.
- C. A pH change can add new molecules to the structure of the enzyme.
- D. A pH change can cause an enzyme to react with a different substrate.



LESSON 1: UNIQUE PROPERTIES OF WATER	P 25 - 32
LESSON 2: ORGANIC MOLECULES: LIPIDS AND CARBOHYDRATES	P 33 - 41
LESSON 3: ORGANIC MOLECULES: DNA AND PROTEINS	P 42 - 47
LESSON 4: ENZYMES	P 48 - 54

Chemical Basis for Life: Keystone Pre-Test Quiz

The questions in this quiz refer to Unit 2: Chemical Basis for Life

1. Water is a _____ molecule, which lends it to many important properties. (polar, nonpolar, ionic, metallic)
2. Compounds like H_2O and CO_2 would be _____, and compounds like $\text{C}_6\text{H}_{12}\text{O}_6$ and $\text{C}_2\text{H}_5\text{O}_2\text{N}$ would be _____. (nonpolar, polar, polar; nonpolar, organic; inorganic, inorganic; organic)
3. Due to maximizing the number of _____ bonds, solid water is actually less dense than liquid water. (metallic, hydrogen, ionic, covalent)
4. A macromolecule contains the elements C, H, and O. It is a polymer of hexagonal rings, and the elements come out to a ratio of ~1:2:1. Which macromolecule would this be? (Carbohydrate, Lipid, Nucleic acid, Protein)
5. A monomer is to a polymer as...? (a polysaccharide is to a monosaccharide; a nucleotide is to nucleic acid; a lipid is to a carbohydrate; a protein is to an amino acid)
6. Which of the following is not a part of an amino acid? (amine group; carboxyl group; phosphate group; radical (R) group)
7. The "lock and key" model refers to (dehydration synthesis; monomers and polymers; an enzyme and a substrate)
8. Hydrolysis involves the _____ of water to _____ a polymer. (removal, break up; removal, build; addition, break up; addition, build DNA)
9. Glucose, a carbohydrate monomer, would be referred to as a(n) (monolipid; monosaccharide; polysaccharide; amino acid)
10. Biological protein catalysts speed up reactions by (lowering activation energy; increasing the reaction temperature; decreasing the amount of reactant collisions; all of the above)

BIOCHEMISTRY GLOSSARY

- Adhesion:** *The intermolecular attraction between unlike molecules. Capillary action results from the Adhesive properties of water and the molecules that make up plant cells.*
- Atom:** *The smallest unit of an element that retains the chemical and physical properties of that element.*
- Carbohydrate:** *A macromolecule that contains atoms of carbon, hydrogen, and oxygen in a 1:2:1 ratio and serves as a major source of energy for living organisms (e.g., sugars, starches, and cellulose).*
- Catalyst:** *A substance that enables a chemical reaction to proceed at a usually faster rate or under different conditions (e.g., lower temperature) than otherwise possible without being changed by the reaction.*
- Cohesion:** *The intermolecular attraction between like molecules. Surface tension results from the cohesive properties of water.*
- Concentration:** *The measure of the amount or proportion of a given substance when combined with another substance.*
- Enzyme:** *A protein that increases the rate of a chemical reaction without being changed by the reaction; an organic catalyst.*
- Freezing Point:** *The temperature at which a liquid changes state to a solid.*
- Lipids:** *A group of organic compounds composed mostly of carbon and hydrogen including a proportionately smaller amount of oxygen; are insoluble in water, serve as a source of stored energy, and are a component of cell membranes.*
- Macromolecule:** *A polymer with a high molecular mass. Within organisms there are four main groups: carbohydrates, lipids, proteins, and nucleic acids.*
- Molecule:** *The smallest particle of a substance that retains the chemical and physical properties of The substance and is composed of two or more atoms held together by chemical forces.*
- Monomer:** *A molecule of any compound that can react with other molecules of the same or different compound to form a polymer. Each biological macromolecule has characteristic monomers.*
- Nucleic Acid:** *A biological macromolecule (DNA or RNA) composed of the elements C, H, N, O, and P that carries genetic information.*
- Organic Molecule:** *A molecule containing carbon that is part of or produced by living systems.*
- pH:** *The measure of acidity or alkalinity (basicity) of an aqueous solution scaling from 1 (highly acidic) to 14 (highly alkaline) with a midpoint of 7 (neutral).*
- Protein:** *A macromolecule that contains the principal components of organisms: carbon, hydrogen,*

oxygen, and nitrogen; performs a variety of structural and regulatory functions for cells.

Specific Heat: *The measure of the heat energy required to increase the temperature of a unit quantity of a substance by a certain temperature interval.*

Temperature: *a measure of the average kinetic energy (energy of motion) of particles in a sample of matter. This physical property can determine the rate and extent to which chemical reactions can occur within living systems. It is commonly measured in degrees Celsius ($^{\circ}\text{C}$) or Fahrenheit ($^{\circ}\text{F}$).*

UNIT 3: BIOENERGETICS

ASSESSMENT ANCHOR BIO.A.3 Bioenergetics		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.A.3.1 Identify and describe the cell structures involved in processing energy.	BIO.A.3.1.1 Describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations.	3.1.B.A2 3.1.B.A5 3.1.C.A1

Sample Exam Question

Standard **BIO.A.3.1.1**

Using a microscope, a student observes a small, green organelle in a plant cell. Which energy transformation **most likely** occurs first within the observed organelle?

- A. ATP to light
- B. light to chemical
- C. heat to electrical
- D. chemical to chemical

ASSESSMENT ANCHOR BIO.A.3 Bioenergetics (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.A.3.2 Identify and describe how organisms obtain and transform energy for their life processes.	BIO.A.3.2.1 Compare the basic transformation of energy during photosynthesis and cellular respiration.	3.1.B.A2 3.1.B.A5 3.1.C.A1 4.1.10.C

Sample Exam Question

Standard **BIO.A.3.2.1**

Photosynthesis and cellular respiration are two major processes of carbon cycling in living organisms. Which statement correctly describes one similarity between photosynthesis and cellular respiration?

- A. Both occur in animal and plant cells.
- B. Both include reactions that transform energy.
- C. Both convert light energy into chemical energy.
- D. Both synthesize organic molecules as end products.

ASSESSMENT ANCHOR		
BIO.A.3 Bioenergetics (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.A.3.2 Identify and describe how organisms obtain and transform energy for their life processes.	BIO.A.3.2.2 Describe the role of ATP in biochemical reactions.	3.1.B.A2 3.1.C.A1 3.1.C.A2

Sample Exam Question

Standard BIO.A.3.2.2

A protein in a cell membrane changed its shape to move sodium and potassium ions against their concentration gradients. Which molecule was **most likely** used by the protein as an energy source?

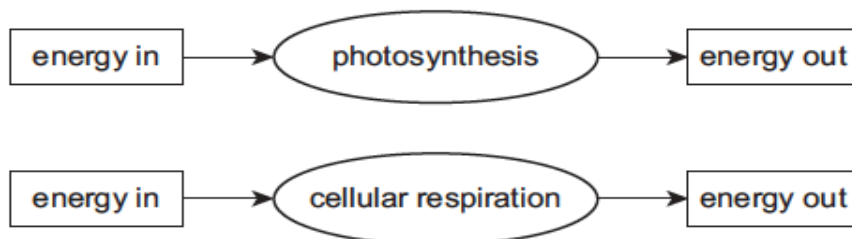
- A. ATP
- B. ADP
- C. catalase
- D. amylase

ASSESSMENT ANCHOR		
BIO.A.3 Bioenergetics (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.A.3.2 Identify and describe how organisms obtain and transform energy for their life processes.	BIO.A.3.2.1 Compare the basic transformation of energy during photosynthesis and cellular respiration.	3.1.B.A2 3.1.B.A5 3.1.C.A1 4.1.10.C

Sample Exam Question

Standard BIO.A.3.2.1

Use the diagrams below to answer the question.



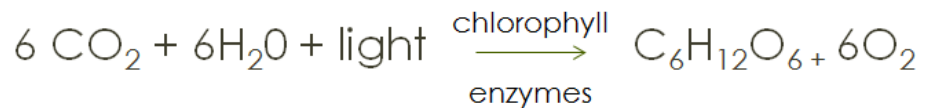
Part A: Complete the chart below by describing energy transformations involved in each process.

Process	Energy Transformations
photosynthesis	
cellular respiration	

Part B: Describe how energy transformations involved in photosynthesis are related to energy transformations involved in cellular respiration.

Cellular Energy (Photosynthesis and Respiration)

Photosynthesis



Plants:

- Autotrophs – they make their own sugars during photosynthesis = Producers - Produce food for all other organisms

Animals:

- Heterotrophs – must get their sugars (carbohydrates) for energy from other sources = Consumers – Consume the food provided by plants

Sun

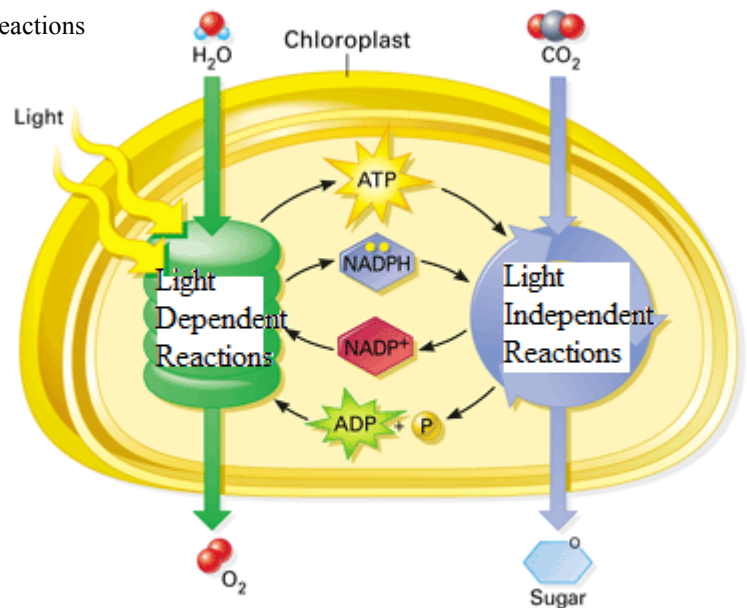
Ultimate source of energy because it provides the energy for the plants which is then passed down to other organisms

Photosynthesis

- The process by which plants convert the sun's energy, water and carbon dioxide to sugar and oxygen (a by-product)
- Takes place in the chloroplasts
- Chlorophyll is the molecule that receives the sun's energy
- Chloroplasts are in the mesophyll cells of the leaves and stems (green parts) just below the surface of the leaf (or stem)

There are two major reactions in photosynthesis

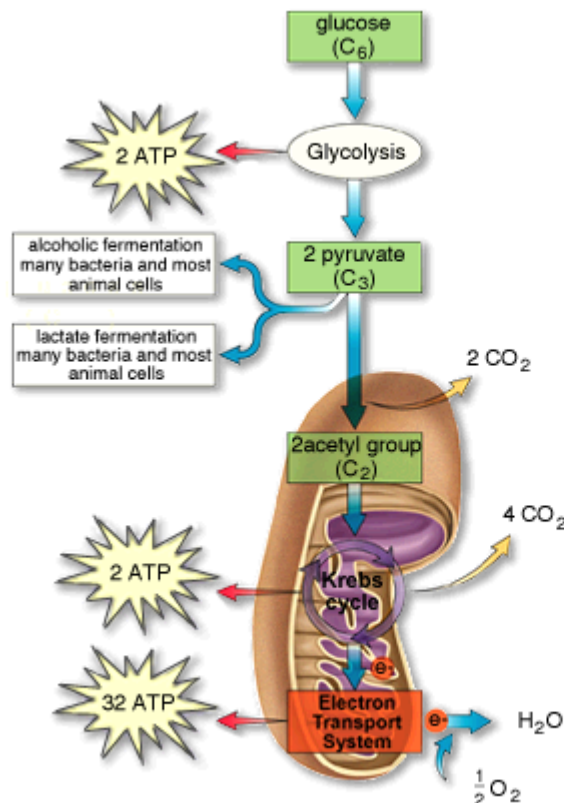
- Light Dependent reactions
 - Aka Light Reactions
 - Aka photolysis
 - Light energy is absorbed by chlorophyll, which uses the energy to split water. Oxygen is released to the outside of the cell, the “H” part of H₂O is carried to the dark reactions with NADPH
 - Some ATP (energy) is made here—will be used up in Light Independent reactions
- Light Independent reactions
 - Aka Dark Reactions
 - Aka Carbon fixation (Calvin Cycle)
 - CO₂ from the outside is combined with the “H” part of NADPH to make sugars for the cell
 - NADP⁺ goes back to light dependent reactions
 - ATP is used to combine the CO₂ and H
 - ADP goes back to light dependent reactions



Respiration

Cellular respiration occurs in the mitochondria of eukaryotic organisms. It is composed of three major steps

1. Glycolysis -- glucose is split into 2 3-carbon compounds and a small amount of energy is released.
 - a. Cytoplasm of all cells
 2. Krebs' cycle – takes 3-carbon compounds and breaks them down into carbon dioxide
 - a. Inner part of mitochondria (matrix)
 3. Electron transport chain – takes electron carriers and materials to create a concentration gradient that ultimately creates ATP
 - a. Inner folds of mitochondria (cristae)
- **Respiration** - I. Breathing [external respiration]; II. oxidative metabolism in which an inorganic substance, usually oxygen, is used as the final electron [hydrogen] acceptor; compare with fermentation.
 - **Glycolysis** - Metabolic pathway found in the cytoplasm that participates in aerobic cellular respiration and fermentation; it converts glucose to two molecules of pyruvate.
 - **Glucose** - Six-carbon sugar that organisms degrade as a source of energy during cellular respiration.
 - **Energy** - Capacity to do work and bring about change; occurs in a variety of forms.



Glucose-the starting compound for aerobic respiration.

Glycolysis- the first stage in respiration in which glucose is split into 2 pyruvate (pyruvic acid) molecules and yields 2 ATP.

CO₂ - The 6 carbons from glucose are lost as 6 carbon dioxide molecules.

Krebs cycle-2 ATP form.

Electron transport system-carrier molecules bring high-energy electrons into the system, powering formation of 32 ATP.

ATP-a total of 36 are produced.

Oxygen- final electron acceptor of electron transport system.

Fermentation-pathways utilized in anaerobic conditions.

In the absence of oxygen, some organisms will use the products of glycolysis and go through fermentation.

- A. Alcoholic fermentation—makes alcohol and CO₂ as the byproducts. Creates no ATP, but “refreshes” carriers so glycolysis can continue
- B. Lactic acid fermentation—makes lactic acid as the byproduct. Creates no ATP, but “refreshes” carriers so glycolysis can continue

Cellular Energy

Please use the link below to guide you

<https://docs.google.com/file/d/0By3MFJ-zJIsYcEVwLWM2bEUzdms/edit>

1. What are examples of autotrophs?
2. What are examples of heterotrophs?
3. The most instant form of energy is known as _____.
4. Why is ATP a high energy molecule?
5. Complete the photosynthesis equation below
$$\text{___ CO}_2 + \text{___ H}_2\text{O} + \text{_____/enzymes} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{___ 6O}_2$$
6. If the photosynthesis equation is reversed, then it is the formula for _____.
7. The _____ dependent reactions and the light _____ reactions make up photosynthesis.
8. Place a "D" if the statement refers to the light dependent reactions and an "I" if it refers to the light independent reactions
____ water is split into oxygen, protons, and electrons
____ CO₂ is taken in and converted into carbohydrates
____ light energy is not needed
____ light energy is needed
9. What initial process splits a molecule of glucose into 2 3-carbon molecules?

10. What is the NET ATP yield from glycolysis? _____
11. What are the two different types of fermentation mentioned?
 - a.
 - b.
12. (Circle one) CO₂ is created during **electron transport chain** / **Kreb's cycle**
13. In the electron transport chain, oxygen joins with electrons and protons to make _____.
14. By going through glycolysis, Kreb's Cycle, and Electron transport chain, a cell can make between _____ and _____ ATP as opposed to just the 2 of glycolysis.



LESSON 1: ATP AND CELLULAR RESPIRATION P 55 – 61

LESSON 2: PHOTOSYNTHESIS P 62 - 66

Keystone Pre-Test

The questions in this quiz refer to: Cellular energy

- The formula $6\text{CO}_2 + 6\text{H}_2\text{O} + \text{light/enzymes} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$ refers to.
 - photosynthesis
 - fermentation
 - respiration
 - oxidation
- For eukaryotes, photosynthesis take place in the _____.
 - mitochondria; polar
 - chloroplast; nonpolar
 - ribosomes; inorganic
 - cytoplasm; organic
- Light-dependent reactions and light-independent reactions refer to
 - fermentation
 - glycolysis
 - respiration
 - photosynthesis
- Glycolysis starts with _____ and breaks it in half to release ____ net ATP.
 - glucose; 2
 - glucose; 4
 - CO_2 ; 2
 - CO_2 ; 4
- Photolysis uses light energy to split a molecule of...
 - glucose
 - water
 - CO_2
 - O_2
- Fermentation takes place
 - in the absence of carbon dioxide
 - in the presence of carbon dioxide
 - in the absence of oxygen
 - in the presence of oxygen
- Which two are practically opposite reactions
 - dark reactions and light reactions
 - fermentation and kreb's cycle
 - photosynthesis and glycolysis
 - photosynthesis and respiration
- The most ATP is generated during.
 - Kreb's cycle and electron transport chain
 - light-dependent and light-independent reactions
 - glycolysis and fermentation
 - light-dependent reactions and fermentation
- Which of the following is a type of fermentation
 - lactic acid
 - alcoholic
 - both A and B
 - neither A nor B
- A mushroom digests a dead log. How would you describe the mushroom?
 - metatroph
 - autotroph
 - heterotroph
 - isotroph

MAKING ENERGY GLOSSARY

- Adenosine Triphosphate (ATP): *A molecule that provides energy for cellular reactions and processes. ATP releases energy when one of its high-energy bonds is broken to release a phosphate group.*
- Biochemical Conversion: *The changing of organic matter into other chemical forms such as fuels.*
- Bioenergetics: *The study of energy flow (energy transformations) into and within living systems.*
- Cellular Respiration: *a complex set of chemical reactions involving an energy transformation where potential chemical energy in the bonds of "food" molecules is released and partially captured in the bonds of adenosine triphosphate (ATP) molecules.*
- Energy Transformation: *A process in which energy changes from one form to another form while some of the energy is lost to the environment.*
- Photosynthesis: *A process in which solar radiation is chemically captured by chlorophyll molecules and through a set of controlled chemical reactions resulting in the potential chemical energy in the bonds of carbohydrate molecules.*

UNIT 4: HOMEOSTASIS AND TRANSPORT

ASSESSMENT ANCHOR		
BIO.A.4 Homeostasis and Transport		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.A.4.1 Identify and describe the cell structures involved in transport of materials into, out of, and throughout a cell.	BIO.A.4.1.1 Describe how the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell.	3.1.B.A5 3.1.B.A2 3.1.B.A4 3.1.B.A7 3.2.C.A1 3.2.P.B6

Sample Exam Question

Standard **BIO.A.4.1.1**

Carbon dioxide and oxygen are molecules that can move freely across a plasma membrane. What determines the direction that carbon dioxide and oxygen molecules move?

- A. orientation of cholesterol in the plasma membrane
- B. concentration gradient across the plasma membrane
- C. configuration of phospholipids in the plasma membrane
- D. location of receptors on the surface of the plasma membrane

ASSESSMENT ANCHOR BIO.A.4 Homeostasis and Transport (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.A.4.1 Identify and describe the cell structures involved in transport of materials into, out of, and throughout a cell.	BIO.A.4.1.2 Compare the mechanisms that transport materials across the plasma membrane (i.e., passive transport—diffusion, osmosis, facilitated diffusion; and active transport—pumps, endocytosis, exocytosis).	3.1.B.A5 3.1.B.A2 3.1.B.A7 3.2.C.A1 3.2.P.B6

Sample Exam Question

Standard **BIO.A.4.1.2**

A sodium-potassium pump within a cell membrane requires energy to move sodium and potassium ions into or out of a cell. The movement of glucose into or out of a cell does not require energy. Which statement **best** describes the movement of these materials across a cell membrane?

- A. Sodium and potassium ions move by active transport, and glucose moves by osmosis.
- B. Sodium and potassium ions move by active transport, and glucose moves by facilitated diffusion.
- C. Sodium and potassium ions move by facilitated diffusion, and glucose moves by osmosis.
- D. Sodium and potassium ions move by facilitated diffusion, and glucose moves by active transport.

ASSESSMENT ANCHOR BIO.A.4 Homeostasis and Transport (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.A.4.1 Identify and describe the cell structures involved in transport of materials into, out of, and throughout a cell.	BIO.A.4.1.2 Compare the mechanisms that transport materials across the plasma membrane (i.e., passive transport—diffusion, osmosis, facilitated diffusion; and active transport—pumps, endocytosis, exocytosis).	3.1.B.A5 3.1.B.A2 3.1.B.A7 3.2.C.A1 3.2.P.B6

Sample Exam Question

Standard **BIO.A.4.1.2**

Some animals can produce a potassium ion concentration inside their cells that is twenty times greater than that of their environment. This ion concentration gradient is maintained by the plasma membrane.

Part A: Identify the process in the cell membrane that produces this difference in concentration.

Part B: Explain the process that occurs as the cell produces the ion concentration gradient.

Part C: Compare the process of potassium ion transport to another mechanism that moves material across the plasma membrane.

ASSESSMENT ANCHOR		
BIO.A.4 Homeostasis and Transport (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.A.4.1 Identify and describe the cell structures involved in transport of materials into, out of, and throughout a cell.	BIO.A.4.1.3 Describe how membrane-bound cellular organelles (e.g., endoplasmic reticulum, Golgi apparatus) facilitate the transport of materials within a cell.	3.1.B.A5 3.1.B.A2

Sample Exam Question

Standard **BIO.A.4.1.3**

The rough endoplasmic reticulum and Golgi apparatus work together in eukaryotic cells. What is one way that the rough endoplasmic reticulum assists the Golgi apparatus?

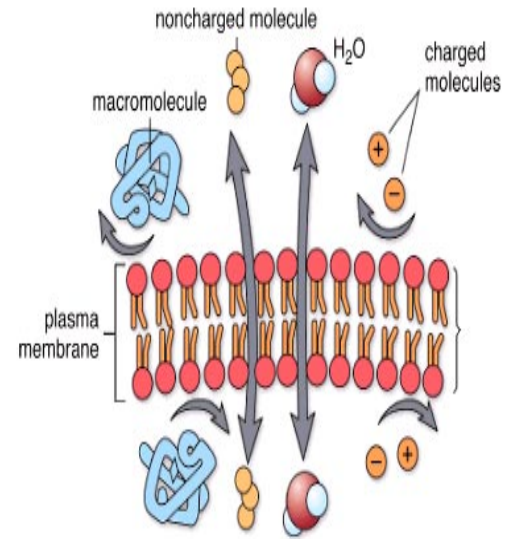
- A. It assembles nucleic acids from monomers.
- B. It breaks down old, damaged macromolecules.
- C. It packages new protein molecules into vesicles.
- D. It determines which protein molecules to synthesize.

Cell Transport

Diffusion Introduction

Water and small, non-charged molecules have no difficulty crossing the lipid portion of the membrane. Ions and charged molecules cannot cross easily, nor can large molecules. It is important that many types of substances be able to enter or leave cells. There is a variety of mechanisms by which this occurs, some requiring energy and some utilizing carrier proteins.

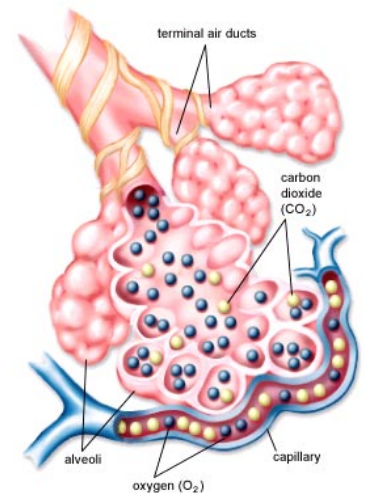
- **Lipid** - Organic compound that is insoluble in water; notably fats, oils, and steroids.
- **Ions** - Atom or group of atoms carrying a positive or negative charge.
- **Energy** - Capacity to do work and bring about change; occurs in a variety of forms.
- **Carrier Protein** - Protein molecule that combines with a substance and transports it through the plasma membrane.



Gas Exchange in the Lungs of Humans

Gas exchange in the lungs occurs by diffusion. Carbon dioxide (CO₂) will follow its concentration gradient into the alveolus, oxygen (O₂) will follow its concentration gradient into the capillary.




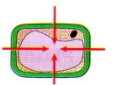
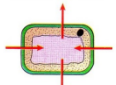
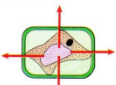
- **Alveolus** - (pl, alveoli) - Air sac of a lung.
- **Capillary** - Microscopic vessel connecting arterioles to venules and through the thin walls of which substances either exit or enter blood.



Osmosis

Osmosis is the diffusion of water across a membrane. Like other molecules, water will move from an area of high concentration to an area of lower concentration. There is terminology to describe concentration differences between two solutions. A solution with a higher concentration of solute is hypertonic relative to one with lower solute concentration. Conversely, a solution with lower solute concentration is hypotonic relative to one with higher solute concentration. If two solutions have the same concentration they are isotonic. Water will move from a hypotonic to a hypertonic solution.

- **Osmosis** - Movement of water from an area of higher concentration of water to an area of lower concentration of water across a differentially permeable membrane.
- **Diffusion** - Movement of molecules from a region of higher concentration to a region of lower concentration.
- **Solute** - Substance dissolved in a solvent to form a solution.
- **Hypertonic** - Solution that has a higher concentration of solute and a lower concentration of water than the cell.
- **Hypotonic** - Solution that has a lower concentration of solute and a higher concentration of water than the cell.

Types of solution			
	Hypotonic	Isotonic	Hypertonic
Description	• A solution which has less solutes than another solution.	• A solution which has the same amount of solutes with another solution.	• A solution which has more solutes than another solution.
Effect on animal cell	• Water enters the cell. • Cell expands and may finally burst (Condition known as haemolysis if involves red blood cells). 		
Effect on plant cell	• Water enters the cell. • Cell becomes very turgid. 		

Facilitated Diffusion

Both simple and facilitated diffusion involve a substance following its concentration gradient, from high to low concentration. If the substance is lipid soluble, it readily passes through the membrane. If it is not lipid soluble, it can cross the membrane only with a specific carrier protein.

Active Transport

Introduction

Active transport involves a protein which uses ATP to pump molecules against their concentration gradients. The same protein may be used to pump two different substances in opposite directions. This is the case for the very important sodium-potassium pump.

- **Active Transport** - Transfer of a substance into or out of a cell from a region of lower concentration to a region of higher concentration by a process that requires a carrier and an expenditure of energy.
- **ATP** - Adenosine Triphosphate (ATP) - Nucleotide with three phosphate groups. The breakdown of ATP into ADP + P_i makes energy available for energy-requiring processes in cells.
- **Sodium-Potassium Pump** - Transport protein in the plasma membrane that moves sodium ions out of and potassium ions into animal cells; important in nerve and muscle cells.

Facilitated Diffusion

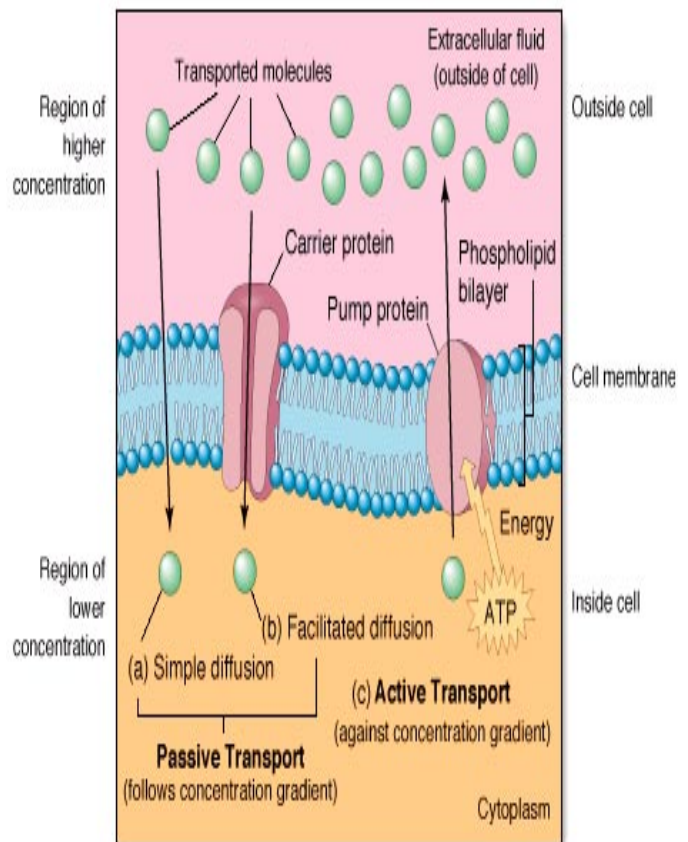
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Passage of Molecules Into and Out of Cells				
	Name	Direction	Requirements	Examples
Passive Transport	Diffusion	Toward lower concentration	Concentration gradient	Lipid-soluble molecules, water, and gases
	Facilitated transport	Toward lower concentration	Carrier and concentration gradient	Sugars and amino acids
Active Transport	Active transport	Toward higher concentration	Carrier plus energy	Sugars, amino acids and ions
	Exocytosis	Toward outside	Vesicle fuses with plasma membrane	Macromolecules
	Endocytosis Phagocytosis	Toward inside	Vacuole formation	Cells and subcellular materials
	Pinocytosis (includes receptor-mediated endocytosis)	Toward inside	Vacuole formation	Macromolecules

Cellular Transport

Please use the link below to guide you

<https://docs.google.com/file/d/0By3MFJ-zJlsYYWVTV1FhRjQ1dzg/edit>

1. What 4 types of organisms have a cell wall?
 - a.
 - b.
 - c.
 - d.
2. Diffusion moves molecules from a _____ concentration to a _____ concentration.
3. True or false: after equilibrium is reached, molecules do not move anymore.
4. In a **hypotonic** solution, there is a low solute / high water concentration outside a cell. Water moves _____ the cell.
5. Circle one: Who does better in a hypotonic solution? **PLANTS** **ANIMALS**
6. In a **hypertonic** solution, there is a high solute / low water concentration outside a cell. Water moves _____ the cell.
7. In an **isotonic** solution, there is an _____ solute / water concentration outside and inside a cell.
8. Circle one: Who does better in an isotonic solution? **PLANTS** **ANIMALS**
9. Facilitated diffusion needs the help of a _____ to move large/charged molecules across a cell membrane.
10. What type of molecule is the “facilitator” in facilitated diffusion? _____
11. The only type of cellular transport to go AGAINST the concentration gradient is called _____.
12. What important energy molecules allows active transport to happen? _____
13. What happens to the shape of the protein when the ATP binds to it?

14. What happens to the shape of the protein when the potassium ions bind to it?

15. In the $\text{Na}^+ \text{K}^+$ pump, _____ ions of sodium go through first. Then, _____ ions of potassium go through.

ASSESSMENT ANCHOR		
BIO.A.4 Homeostasis and Transport (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.A.4.2 Explain mechanisms that permit organisms to maintain biological balance between their internal and external environments.	BIO.A.4.2.1 Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).	3.1.B.A8 3.1.B.A5 4.5.4.D 4.2.4.C

Sample Exam Question

Standard BIO.A.4.2.1

Which example is an activity that a fish **most likely** uses to maintain homeostasis within its body?

- A. using camouflage to avoid predators
- B. feeding at night to regulate body temperature
- C. moving to deeper water to regulate metabolic wastes
- D. exchanging gases through its gills to regulate oxygen levels



LESSON 1: MEMBRANES OF THE CELL	P 67 – 74
LESSON 2: PASSIVE TRANSPORT	P 75 – 82
LESSON 3: ACTIVE TRANSPORT	P 83 – 88
LESSON 4: HOMEOSTASIS	P 89 – 96

MODULE A REVIEW – CELLS AND CELL PROCESSES	P 97 - 104
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Keystone PRE-TEST

The questions in this quiz refer to: Cellular Transport

1. Molecules naturally move from an area of ____ concentration to an area of ____ concentration..
A. high...high B. low...low C. high...low D. low...high
2. This cell barrier refers to the "fluid mosaic mode" and is highly selective about what passes through
A. gap junction B. cell wall C. nuclear membrane D. cell membrane
3. Which of these is the most likely to diffuse through a cell membrane
A. small, nonpolar molecule B. ion C. large molecule D. polar molecule
4. Which form of cellular transport moves AGAINST the concentration gradient?
A. active transport B. osmosis C. diffusion D. facilitated diffusion
5. Water will exit the cell when placed in a/n ____ environment
A. polar B. hypotonic C. hypertonic D. isotonic
6. Which of the following organisms does NOT have a cell wall??
A. E. coli B. roses C. portabella mushroom D. giraffe
7. Facilitated diffusion uses which macromolecule to help move items across?
A. nucleic acid B. protein C. lipid D. carbohydrate
8. The sodium potassium pump is an example of
A. removal; facilitated diffusion B. removal; active transport C. addition; osmosis
D. addition; diffusion
9. The diffusion of water across a membrane is known as
A. facilitated diffusion B. active transport C. osmosis D. diffusion
10. Plants typically prefer to be in a/n ____ environment.
A. hypotonic B. hypertonic C. ionic D. isotonic

CELL TRANSPORT GLOSSARY

- Active Transport:** *The movement of particles from an area of low concentration to an area of high energy provided by ATP or a difference in electrical charges across a cell membrane.*
- Carrier (Transport) Proteins:** *Proteins embedded in the plasma membrane involved in the movement of ions, small molecules, and macromolecules into and out of cells; also known as transport proteins.*
- Concentration Gradient:** *The graduated difference in concentration of a solute per unit distance through a solution.*
- Diffusion:** *The movement of particles from an area of high concentration to an area of low concentration; a natural result of kinetic molecular energy.*
- Exocytosis:** *A process in which a cell releases substances to the extracellular environment by fusing a vesicular membrane with the plasma membrane, separating the membrane at the point of fusion and allowing the substance to be released.*
- Facilitated Diffusion:** *A process in which substances are transported across a plasma membrane with the concentration gradient with the aid of carrier (transport) proteins; does not require the use of energy.*
- Homeostasis:** *The regulatory process in which an organism regulates its internal environment.*
- Homeostatic Mechanism:** *A regulatory mechanism that contributes to maintaining a state of equilibrium (e.g., thermoregulation, water regulation, and oxygen regulation).*
- Impermeable:** *Not permitting passage of a substance or substances.*
- Intracellular:** *Located inside a cell.*
- Osmosis:** *The movement of water or another solvent through permeable membranes from an area of higher water concentration (dilute) to an area of lower water concentration (concentrated).*
- Passive Transport:** *The transportation of materials across a plasma membrane without using energy.*
- Plasma Membrane:** *A thin, phospholipid and protein molecule bilayer that encapsulates a cell and controls the movement of materials in and out of the cell through active or passive transport.*
- Pumps (Ion or Molecular):** *Any of several molecular mechanisms in which ions or molecules are transported across a cellular membrane requiring the use of an energy source (e.g., glucose, sodium [Na⁺], calcium [Ca⁺], and potassium [K⁺]).*

Constructed Response Questions

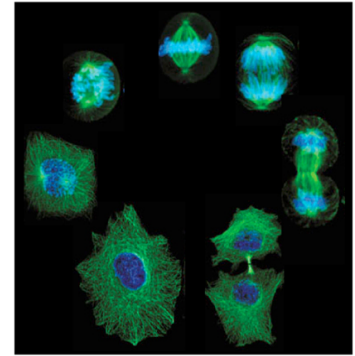
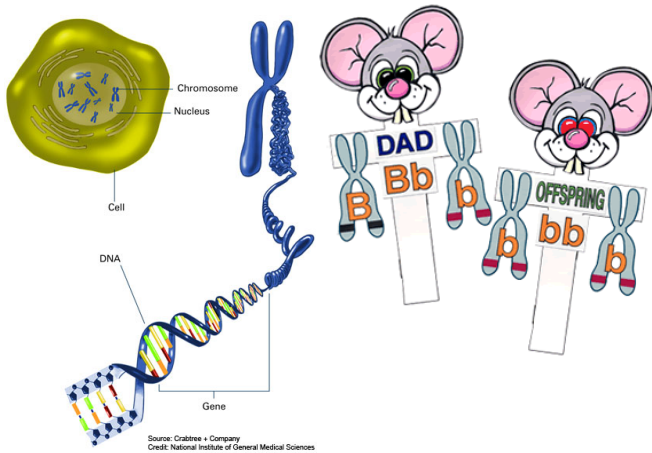
Subject	Biology
Unit Name	Cellular Processes
<p>Homeostasis is the ability or tendency of an organism or cell to maintain internal equilibrium by adjusting its physiological processes.</p> <ul style="list-style-type: none"> How does a cell maintain homeostasis? What could potentially happen if a cell does not maintain homeostasis? 	
<p>Complex organisms are composed of many types of cells.</p> <ul style="list-style-type: none"> Describe the hierarchy of organisms from a cellular level and give an example of each level. (Cells make up . . . , which then make up) Give examples of 3 types of cells in your body and their function in helping your body maintain proper functioning. 	
<p>The cell membrane gives a cell its support and shape.</p> <ul style="list-style-type: none"> List and describe three processes used by cells to control the movement of substances across the cell membrane. What could/would happen to a cell if the cell membrane was damaged? 	
<p>Stem cell research is a current ethical issue in science.</p> <ul style="list-style-type: none"> Describe how stem cells are being used today. Give specific examples. Do you agree with stem cell research? Explain your reasoning with specific examples. 	
<p>Mitosis and meiosis are important cellular reproduction processes.</p> <ul style="list-style-type: none"> Describe the steps in mitosis and meiosis and discuss the main differences in these processes. Give an example of a cell type in your body that undergoes mitosis and meiosis. 	
<p>The cell cycle is a repeating set of events in the life of a cell.</p> <ul style="list-style-type: none"> Describe the three main checkpoints at which the cell cycle is controlled. Predict what would happen if mitosis happened before S phase of the cell cycle. 	
<p>Enzymes speed up chemical reactions and bind to specific substrates.</p> <ul style="list-style-type: none"> Summarize the induced fit model of enzyme activity. What would happen if an enzyme was blocked from catalyzing a reaction? 	
<p>The human body is approximately 65-70% water. The ocean is 33.5ppt dissolved salts. If a human were to be submerged in seawater over a long period of time then that person would suffer from dehydration.</p> <ul style="list-style-type: none"> Explain what type of cellular transport is at work in the scenario above and why the body allows this to happen. What efforts could you take to prepare yourself for prolonged exposure to the sea such as a day at the beach? Why is water balance necessary? Use specific details to support your answer! 	

MODULE B

CONTINUITY AND UNITY OF LIFE

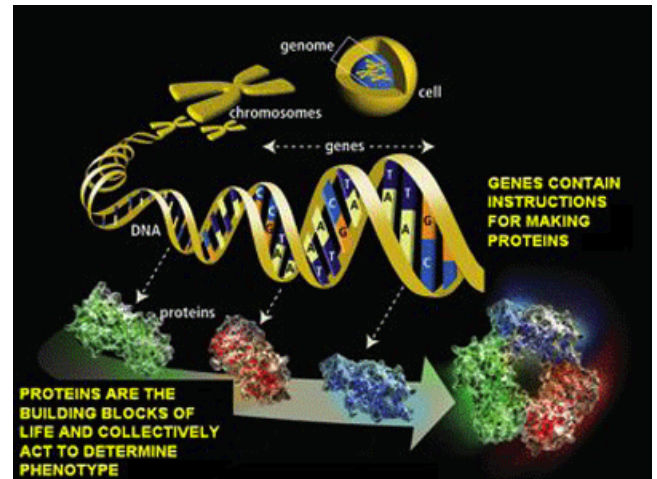
BIG Ideas in Module B

#1: New **cells** arise from the division of pre-existing cells.

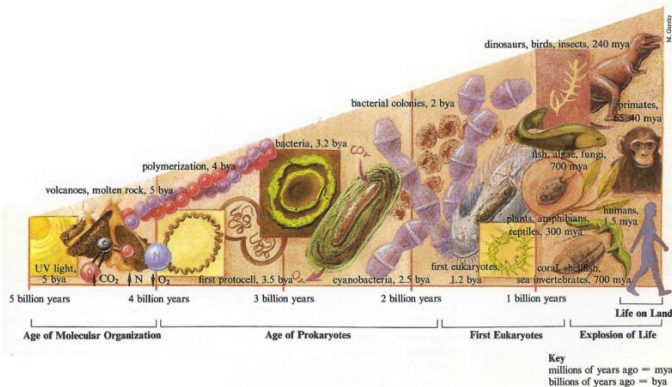


#2: Hereditary information in **genes** is transmitted across generations via **DNA**.

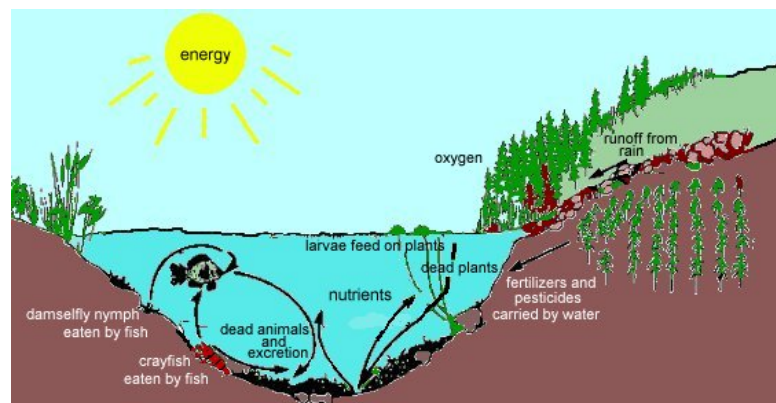
#3: **DNA** segments contain information for the production of **proteins** necessary for growth and function of **cells**.



#4: **Evolution** is the result of many random processes selecting for the survival and reproduction of a population.



#5: Organisms on Earth interact and depend in a variety of ways on other living and nonliving things in their environments (**ecology**).



UNIT 5: CELL GROWTH AND RESPIRATION

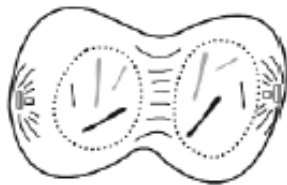
ASSESSMENT ANCHOR		
BIO.B.1 Cell Growth and Reproduction		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.B.1.1 Describe the three stages of the cell cycle: interphase, nuclear division, cytokinesis.	BIO.B.1.1.1 Describe the events that occur during the cell cycle: interphase, nuclear division (i.e., mitosis or meiosis), cytokinesis.	3.1.B.A4 3.1.B.A5 3.1.B.B2 3.1.B.B3 3.1.B.B5 3.1.B.C2 3.1.C.C2

Sample Exam Question

Standard BIO.B.1.1.1

Use the illustration below to answer the question.

Cell Division



Which statement **best** describes the phase of the cell cycle shown?

- A. The cell is in prophase of mitosis because the number of chromosomes has doubled.
- B. The cell is in prophase I of meiosis because the number of chromosomes has doubled.
- C. The cell is in telophase of mitosis because the cell is separating and contains two copies of each chromosome.
- D. The cell is in telophase of meiosis because the cell is separating and contains two copies of each chromosome.

ASSESSMENT ANCHOR		
BIO.B.1 Cell Growth and Reproduction (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.B.1.1 Describe the three stages of the cell cycle: interphase, nuclear division, cytokinesis.	BIO.B.1.1.2 Compare the processes and outcomes of mitotic and meiotic nuclear divisions.	3.1.B.A4 3.1.B.A5 3.1.B.B2 3.1.B.B3 3.1.B.B5 3.1.B.C2 3.1.C.C2

Sample Exam Question

Standard **BIO.B.1.1.2**

Mitosis and meiosis are processes by which animal and plant cells divide. Which statement **best** describes a difference between mitosis and meiosis?

- A. Meiosis is a multi-step process.
- B. Mitosis occurs only in eukaryotic cells.
- C. Meiosis is used in the repair of an organism.
- D. Mitosis produces genetically identical daughter cells.

ASSESSMENT ANCHOR		
BIO.B.1 Cell Growth and Reproduction (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.B.1.1 Describe the three stages of the cell cycle: interphase, nuclear division, cytokinesis.	BIO.B.1.1.2 Compare the processes and outcomes of mitotic and meiotic nuclear divisions.	3.1.B.A4 3.1.B.A5 3.1.B.B2 3.1.B.B3 3.1.B.B5 3.1.B.C2 3.1.C.C2

Sample Exam Question

Standard BIO.B.1.1.2

Patau syndrome can be a lethal genetic disorder in mammals, resulting from chromosomes failing to separate during meiosis.

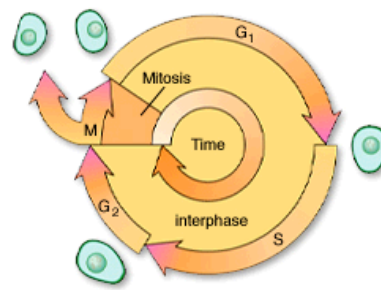
Part A: Identify the step during the process of meiosis when chromosomes would **most likely** fail to separate.

Part B: Describe how chromosome separation in meiosis is different from chromosome separation in mitosis.

Part C: Compare the effects of a disorder caused by chromosomes failing to separate during meiosis, such as Patau syndrome, to the effects of chromosomes failing to separate during mitosis.

Cell Division

Introduction



- G₁ - Normal functions are performed and organelles begin to double in number for mitosis
- S - Replication of DNA
- G₂ - Synthesis of proteins that control cell division
- M - Mitosis

Mitosis is one of the stages in the life cycle of a cell. It refers to the division of the nucleus.

- **Mitosis** - Type of cell division in which daughter cells receive the exact chromosome and genetic makeup of the parent cell; occurs during growth and repair.
- **Nuclei** - Cell organelles containing most of the genetic material of the cell; collection of nerve cell bodies within the central nervous system; center of an atom consisting of protons and neutrons.

Stages of Mitosis

Mitosis is the process by which the contents of the eukaryotic nucleus are separated into 2 genetically identical packages. Chromosomes replicate prior to the beginning of mitosis. As mitosis begins they condense and become visible under a light microscope. They appear as sister chromatids joined at the centromere. Mitosis is divided into 4 stages. During prophase, the nuclear envelope disintegrates and a spindle of microtubules forms. Centrioles may help organize the spindle as in this animal cell. The chromosomes begin to move toward the midplane of the spindle. When they are on the midplane with centromeres attached to spindle fibers, the second stage, metaphase has been reached. Metaphase yields to anaphase as the centromeres separate and the sister chromatids, now termed chromosomes, are pulled toward opposite poles of the spindle. During the final stage, telophase, a nuclear envelope forms around each set of chromosomes, the spindle disappears and the chromosomes decondense. The result is 2 nuclei, each with an identical set of chromosomes. Cytokinesis is the division of the cell contents outside of the nucleus. It occurs with both mitosis and meiosis. In cells without walls, it is accomplished by pinching of the cell. In plant cells, the wall prevents pinching; instead vesicles line up along the middle of the cell. As they fuse they form the separation between daughter cells.

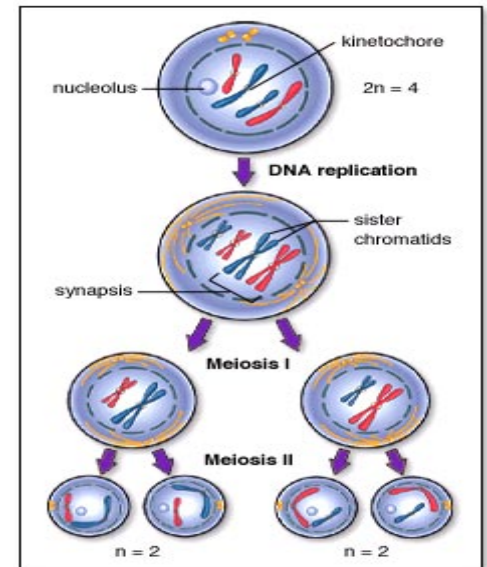
- **Eukaryotic Cell** - Cell that possesses a nucleus and the other membranous organelles characteristic of complex cells.
- **Chromosome** - Rodlike structure in the nucleus seen during cell division; contains the hereditary units, or genes.
- **Sister Chromatid** - One of two genetically identical chromosomal units that are the result of DNA replication and are attached to each other at the centromere.
- **Centromere** - Constricted region of a chromosome where sister chromatids are attached to one another and where the chromosome attaches to a spindle fiber.
- **Prophase** - Mitosis phase during which chromatin condenses so that chromosomes appear.
- **Microtubule** - Organelle composed of 13 rows of globular proteins; found in multiple units within other organelles, such as the centriole, cilia, flagella, as well as spindle fibers.
- **Centriole** - Short, cylindrical organelle in animal cells that contains microtubules in a 9 1 0 pattern; present in a centrosome and associated with the formation of basal bodies.
- **Metaphase** - Mitosis phase during which chromosomes are aligned at the metaphase plate (equator) of the mitotic spindle.

- **Telophase** - Mitosis phase during which the diploid number of daughter chromosomes are located at each pole.

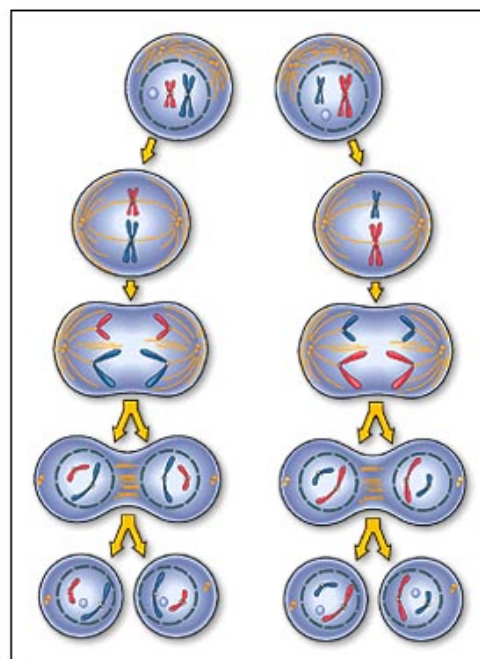
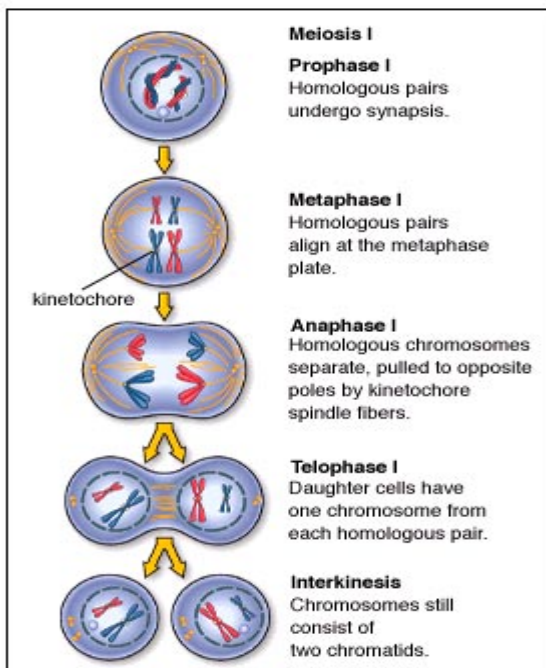
Meiosis

The ultimate goal of the process of meiosis is to reduce the number of chromosomes by half. This must occur prior to sexual reproduction. The cell at the top contains two homologous pairs of chromosomes, for a total of four chromosomes. The final products of meiosis, four daughter cells, each contain one chromatid from each original homologous pair, for a total of two chromosomes. There are two stages of meiosis to accomplish this task

- **Sexual Reproduction** -Reproduction that occurs through fusion of two gametes



Meiosis I reduces the chromosome number in half, but each chromosome contains two sister chromatids. Meiosis II



Meiosis is the process by which a diploid nucleus divides twice to produce 4 haploid nuclei. The divisions are called meiosis I and meiosis II. In the life cycles of diploid organisms meiosis precedes sexual reproduction. Among animals, the products of meiosis are gametes-eggs or sperm. DNA is replicated prior to the start of meiosis. The identical sister chromatids are joined at the centromere as in mitosis. Unlike in mitosis, homologous chromosomes pair

with one another. These pairs intertwine during early prophase of the first meiotic division and may exchange segments. This exchange is called crossing over. During prophase I, the nuclear envelope disappears and the spindle forms. The homologous pairs lie side by side as they reach the midplane of the spindle and attach to spindle fibers in Metaphase I. Metaphase ends and Anaphase I begins as the partners in each pair of homologous chromosomes separate as they are pulled toward opposite poles of the spindle. These chromosomes still consist of sister chromatids joined at their centromeres. During Telophase I the spindle disappears, nuclear membranes may re-form and the 2 nuclei, each containing a haploid set of chromosomes, are separated as cytokinesis divides the cytoplasm. Prophase II begins with the formation of a spindle and the still duplicated chromosomes move toward its mid-plane. At Metaphase II they are lined up and attached to spindle fibers. Anaphase II begins when centromeres separate and sister chromatids, now considered chromosomes, begin moving in opposite directions. During Telophase II the nuclear membrane re-forms, the spindle disappears and cytokinesis divides the cytoplasm. The result is 4 haploid cells.

Cell Division

Please use the [Council Rock Video Podcast](#) to guide you

<https://docs.google.com/file/d/0By3MFJ-zJlsYdVR4OGstTTdGLWs/edit>

1. What are the three reasons that cells typically divide?
 - a.
 - b.
 - c.
2. **Circle one:** The longest phase of the cell cycle is **INTERPHASE / MITOSIS**
3. G_1 is about cells _____.
4. How does a duplicated strand of DNA end up being identical to the original strand?
5. The last stage of Interphase is _____.
6. In mitosis, the goal is to get cells that are genetically _____. That is, we want to go $2N \rightarrow 2N$.
7. Match the following Mitosis stages to what happens
 - ___ Prophase
 - ___ Metaphase
 - ___ Anaphase
 - ___ Telophase
 - a. Chromosomes move to opposite ends of cell
 - b. Nucleus reforms, DNA loosens, last stage
 - c. DNA condenses; nuclear breaks down
 - d. Chromosomes line up in middle of cell
8. What is the difference between plant and animal telophase/cytokinesis?
9. What does meiosis do to the number of chromosomes? _____
10. Meiosis goes from $2N \rightarrow$ _____, or from diploid \rightarrow _____
11. What is crossing over?
12. When does crossing over happen? _____
13. What is the idea of Independent assortment?
14. When chromosomes fail to separate properly, it is known as _____.
 - a. _____ syndrome and Patau syndrome are results of nondisjunction.

Keystone Pre-Test

The questions in this quiz refer to: Cellular Division

1. Which of these is not part of interphase
a. G₂ b. G₁ c. M d. S
2. The process of mitosis results in...
a. four 1N cells b. four 2N cells c. two 1N cells d. two 2N cells
3. The process of meiosis results in...
a. four 1N cells b. four 2N cells c. two 1N cells d. two 2N cells
4. Crossing over occurs during
a. prophase I b. metaphase II c. anaphase I d. telophase II
5. The replication of genetic material occurs during
a. G₀ b. metaphase c. S phase d. anaphase
6. In mitosis, sister chromatids move towards opposite ends of the cell during which phase?
a. telophase b. prophase c. metaphase d. anaphase
7. What is the difference between plant and animal mitosis?
a. plants use centrioles; animals use a cell wall to split the cell contents
b. plant cells have a cell plate; animals have a cleavage furrow
c. animals reduce their chromosome number; plants don't
d. plants do not go through telophase
8. The nuclear membrane / envelope breaks down during
a. telophase b. prophase c. anaphase d. metaphase
9. Meiosis results in the production of
a. 2 haploid cells b. 2 diploid cells c. 4 haploid cells d. 4 diploid cells
10. The failure of chromosomes to separate during meiosis is known as
a. nondisjunction b. independent assortment c. synapsis d. none of the above

MEIOSIS AND MITOSIS GLOSSARY

- Cell Cycle:** *The series of events that take place in a cell leading to its division and duplication. The main phases of the cell cycle are interphase, nuclear division, and cytokinesis.*
- Chromosomal Mutation:** *A change in the structure of a chromosome (e.g., deletion- the loss of a segment of a chromosome and thus the loss of segment containing genes; duplication- when a segment of a chromosome is duplicated and thus displayed more than once in a chromosome; inversion- when a segment of a chromosome breaks off and reattaches in reverse order; and translocation- when a segment of one chromosome breaks off and attaches to a nonhomologous chromosome.*
- Chromosomes:** *A single piece of coiled DNA and associated proteins found in linear forms in the nucleus of eukaryotic cells and circular forms in the cytoplasm of prokaryotic cells; contains genes that encode traits. Each species has a characteristic number of chromosomes.*
- Crossing-over:** *An exchange of genetic material between homologous chromosomes during anaphase I of meiosis; contributes to the genetic variability in gametes and ultimately in offspring.*
- Cytokinesis:** *The final phase of a cell cycle resulting in the division of the cytoplasm.*
- Deoxyribonucleic Acid (DNA):** *A biological macromolecule that encodes the genetic information for living organisms and is capable of self-replication and the synthesis of ribonucleic acid (RNA).*
- DNA Replication:** *The process in which DNA makes a duplicate copy of itself.*
- Gamete:** *A specialized cell (egg or sperm) used in sexual reproduction containing half the normal number of chromosomes of a somatic cell.*
- Interphase:** *The longest-lasting phase of the cell cycle in which a cell performs the majority of its functions, such as preparing for nuclear division and cytokinesis.*
- Meiosis:** *A two-phase nuclear division that results in the eventual production of gametes with half the normal number of chromosomes.*
- Mitosis:** *A nuclear division resulting in the production of two somatic cells having the same genetic complement as the original cell.*
- Nondisjunction:** *The process in which sister chromatids fail to separate during and after mitosis or meiosis.*

ASSESSMENT ANCHOR		
BIO.B.1 Cell Growth and Reproduction (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.B.1.2 Explain how genetic information is inherited.	BIO.B.1.2.1 Describe how the process of DNA replication results in the transmission and/or conservation of genetic information.	3.1.B.B1 3.1.B.B3 3.1.B.B5 3.1.B.C2 3.1.C.C2
	BIO.B.1.2.2 Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in inheritance.	3.1.B.B1 3.1.B.B5 3.1.B.B2 3.1.B.B3 3.1.C.C2

Sample Exam Questions

Standard BIO.B.1.2.1

Which process helps to preserve the genetic information stored in DNA during DNA replication?

- A. the replacement of nitrogen base thymine with uracil
- B. enzymes quickly linking nitrogen bases with hydrogen bonds
- C. the synthesis of unique sugar and phosphate molecules for each nucleotide
- D. nucleotides lining up along the template strand according to base pairing rules

Standard BIO.B.1.2.2

In a flowering plant species, red flower color is dominant over white flower color. What is the genotype of any red-flowering plant resulting from this species?

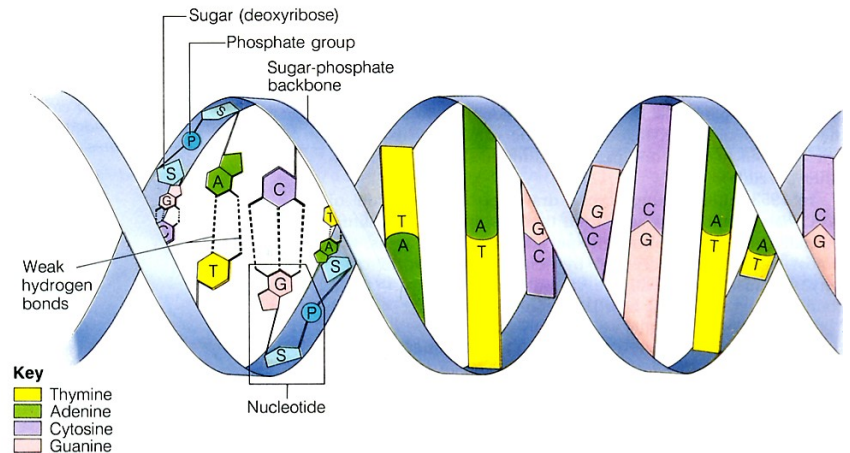
- A. red and white alleles present on one chromosome
- B. red and white alleles present on two chromosomes
- C. a red allele present on both homologous chromosomes
- D. a red allele present on at least one of two homologous chromosomes

DNA and its Processes

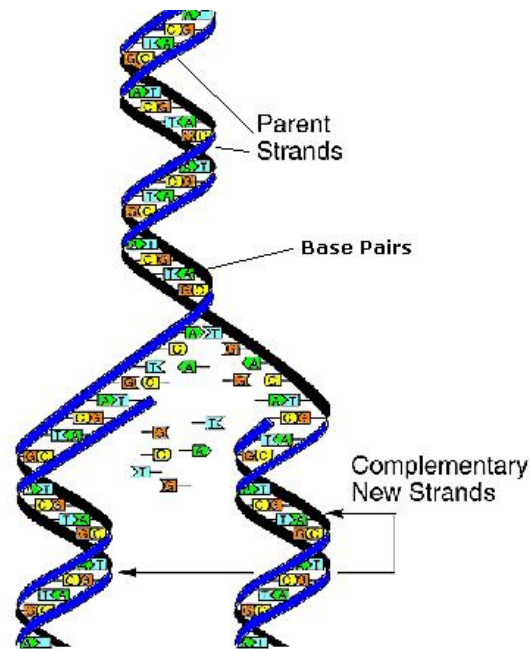
DNA Structure

Deoxyribonucleic acid (DNA) is an important biomolecule that contains our genetic code. Here is a diagram of the double helix model of DNA. Note that the monomers/building blocks of DNA are called nucleotides. Each nucleotide contains three parts

- Sugar (deoxyribose)
- Phosphate group
- Nitrogenous base (4 kinds)



DNA Replication

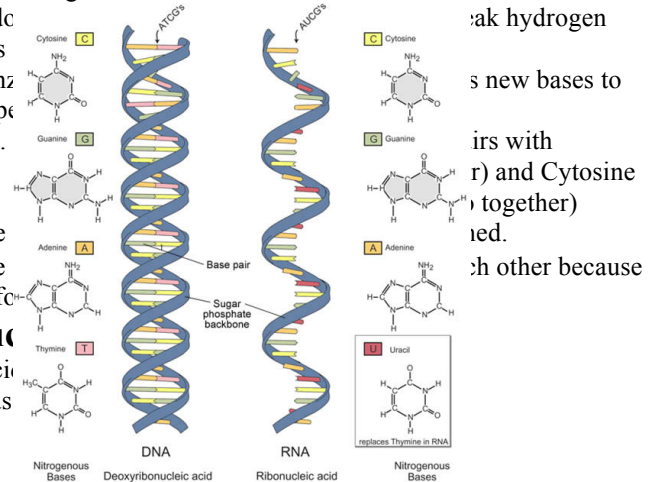


In order for new cells to pass on the genetic code, DNA must be copied inside of cells. In eukaryotic cells, this takes place inside of the nucleus, which stores the cell's DNA. In prokaryotes, the process of copying DNA occurs in the cytoplasm. Regardless of location, the process is known as replication. Two daughter strands are formed.

1. The dc bonds
2. An enz the op
3. At the
4. These they fo

RNA Struc

Ribonucleic aci
However, it has

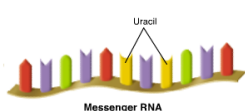


	Deoxyribonucleic acid (DNA)	Ribonucleic acid (RNA)
Number of strands	2	1
Sugar	Deoxyribose	Ribose
Base pairs	A-T G-C	A-U G-C

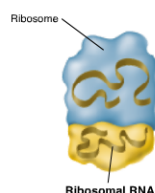
In addition to those differences, there are three differ

Ribosomal rna (rRNA) is a component of the ribosome and the site of protein synthesis

erent types have various shapes and functions.



Messenger RNA (mRNA) carries the transcribed message from DNA to the ribosome to make proteins



Ribosomal RNA

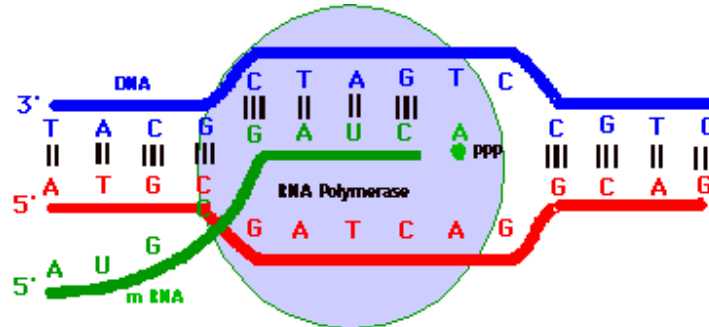


Transfer RNA

Transfer RNA (tRNA) brings the amino acids to the ribosome for protein synthesis

Transcription

This occurs in the nucleus of eukaryotes. In the process of transcription, an mRNA transcript is made using the double helix as a template. The double-stranded molecule of DNA separates along the hydrogen bonds. An enzyme called RNA polymerase adds in corresponding base pairs. However, instead of using Thymine to match up with Adenine, Uracil is used. For RNA, the base pairing rules are A-U and G-C. At the end of this process, one piece of mRNA is created. It is complementary to the strand of DNA it was formed from.

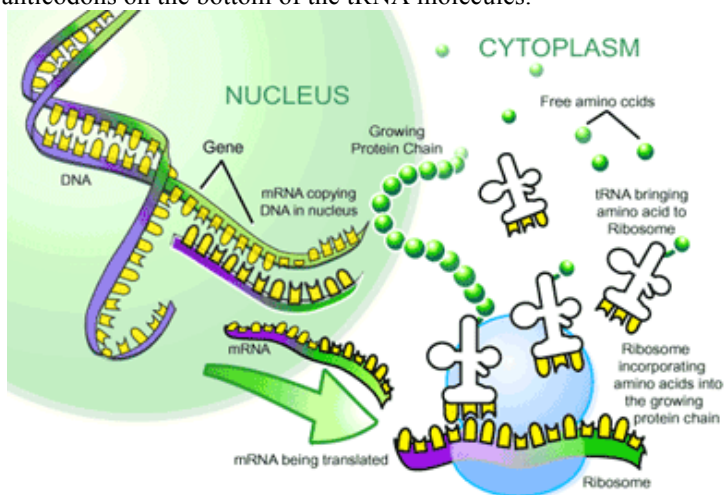


Translation

This process occurs in the cytoplasm. In the process of translation, the piece of mRNA is read by the ribosome in groups of three letters (codons). Each 3-letter portion of mRNA is referred to as a codon and codes for a specific amino acid. These codes match up to the anticodons on the bottom of the tRNA molecules. The corresponding tRNA molecule brings in the correct amino acid (building block of proteins). The ribosome joins the amino acids together to make a protein.

The diagram on the left shows replication, transcription, and translation all happening in the cell. The diagram on the right shows a chart of the 64 codons that make up the genetic code and the 20 amino acids that match up.

Each 3-letter portion of mRNA is referred to as a codon and codes for a specific amino acid. These codes match up to the anticodons on the bottom of the tRNA molecules.



		Second base					
		U	C	A	G		
First base	U	UUU } Phenyl-alanine UUC } UUA } Leucine UUG }	UCU } UCC } Serine UCA } UCG }	UAU } Tyrosine UAC } UAA } Stop codon UAG }	UGU } Cysteine UGC } UGA } Stop codon UGG } Tryptophan	Third base	U C A G
	C	CUU } Leucine CUC } CUA } CUG }	CCU } CCC } Proline CCA } CCG }	CAU } Histidine CAC } CAA } Glutamine CAG }	CGU } CGC } Arginine CGA } CGG }		U C A G
	A	AUU } Isoleucine AUC } AUA } Methionine start codon AUG }	ACU } ACC } Threonine ACA } ACG }	AAU } Asparagine AAC } AAA } Lysine AAG }	AGU } Serine AGC } AGA } Arginine AGG }		U C A G
	G	GUU } Valine GUC } GUA } GUG }	GCU } GCC } Alanine GCA } GCG }	GAU } Aspartic acid GAC } GAA } Glutamic acid GAG }	GGU } GGC } Glycine GGA } GGG }		U C A G

Mutations

Many different types of mutations can occur. They can either affect a few nucleotides (point mutations) or affect large portions of DNA (chromosomal mutations). These will ultimately affect the shape and size of the protein constructed, and the appearance of the cell or organism.

(a) Point mutations and small deletions

Wild-type sequences

Amino acid N-Phe Arg Trp Ile Ala Asn-C
 mRNA 5'-UUU CGA UGG AUA GCC AAU-3'
 DNA 3'-AAA GCT ACC TAT CGG TTA-5'
 5'-TTT CGA TGG ATA GCC AAT-3'

Missense

3'-AAT GCT ACC TAT CGG TTA-5'
 5'-TTA CGA TGG ATA GCC AAT-3'
 N-Leu Arg Trp Ile Ala Asn-C

Nonsense

3'-AAA GCT ATC TAT CGG TTA-5'
 5'-TTT CGA TAG ATA GCC AAT-3'
 N-Phe Arg Stop

Frameshift by addition

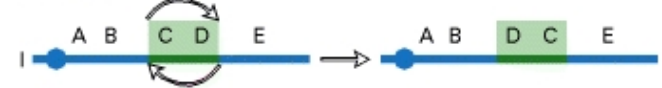
3'-AAA GCT ACC ATA TCG GTT A-5'
 5'-TTT CGA TGG TAT AGC CAA T-3'
 N-Phe Arg Trp Tyr Ser Gln

Frameshift by deletion

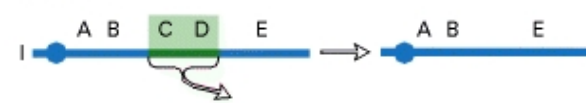
GCTA
 CGAT
 3'-AAA CCT ATC GGT TA-5'
 5'-TTT GGA TAG CCA AT-3'
 N-Phe Gly Stop

(b) Chromosomal abnormalities

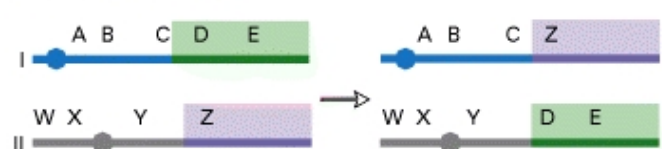
Inversion



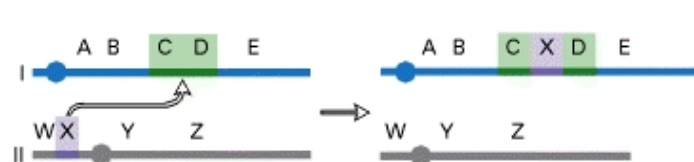
Deletion



Balanced translocation



Insertion

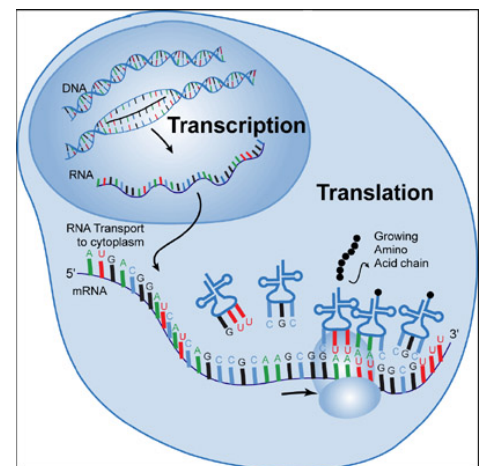
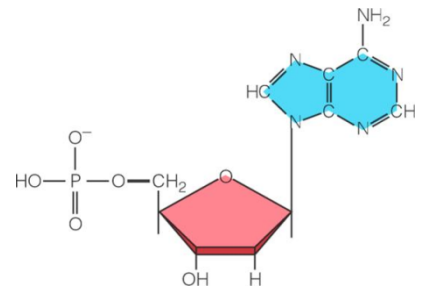


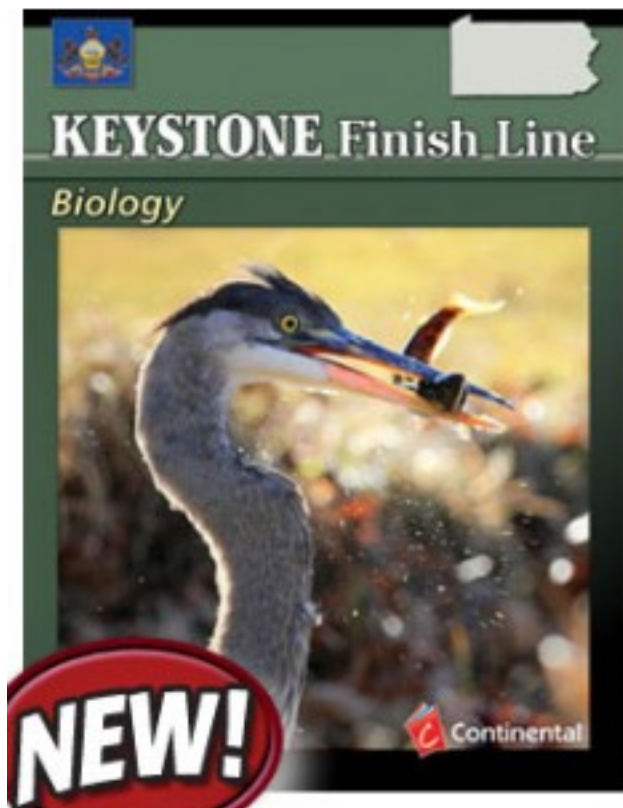
DNA and its processes

Please use the [link below](https://docs.google.com/file/d/0By3MFJ-zJlsYRDVtOEJWZnJpN1k/edit) to guide you

<https://docs.google.com/file/d/0By3MFJ-zJlsYRDVtOEJWZnJpN1k/edit>

1. Label the three parts of a nucleotide to the right.
2. DNA has _____ strands and the bases ____denine, ____ymine, ____tosine, and ____uanine.
3. RNA has _____ strand and the base ____racil instead of thymine.
4. What are the functions of
mRNA? _____
tRNA? _____
rRNA? _____
5. What are the three different processes that nucleic acid can do?
 - a. _____
 - b. _____
 - c. _____
6. What happens during replication?
7. What happens during transcription?
8. What does AUG code for? _____
9. What do UGA, UAA, and UAG code for? _____
10. What happens during translation?
11. What is the **biology** definition of a mutation?
12. What happens during
 - a. Substitution mutation
 - b. Insertion point mutation
 - c. Deletion point mutation
 - d. Duplication chromosomal mutation
 - e. Deletion chromosomal mutation
 - f. Inversion chromosomal mutation
 - g. Translocation chromosomal mutation





LESSON 1: GENES AND PROTEIN SYNTHESIS	P 105 – 113
LESSON 2: THE CELL CYCLE, DNA REPLICATION, AND MITOSIS	
P 114 – 121
LESSON 3: GENES, ALLELES, AND MEIOSIS	P 122 – 130

Keystone Pre-Test

The questions in this quiz refer to: DNA and its processes

1. Which of the following is NOT part of a nucleotide?
a. 5-carbon sugar b. phospholipid c. nitrogenous base d. phosphate group
2. Making an mRNA strand based on DNA is called
a. transcription b. translation c. transformation d. replication
3. What type of bonds connect the two strands of DNA?
a. metallic b. hydrogen c. ionic d. covalent
4. A group of 3 nucleotides read by a ribosome is referred to as a(n)
a. transfer RNA molecule b. codon c. enzyme d. isomer
5. Translation does which?
a. DNA --> DNA b. DNA --> RNA c. RNA --> protein d. RNA --> RNA
6. AATTGC --> ACTTGC would be what type of mutation?
a. frameshift b. deletion c. insertion d. substitution
7. AATTGC --> ATTGC would be what type of mutation?
a. deletion b. translocation c. substitution d. insertion
8. Which of the following describes replication?
a. RNA --> DNA b. RNA --> protein c. DNA --> RNA d. DNA --> DNA
9. Which of the following is NOT a type of RNA?
a. mRNA b. tRNA c. dRNA d. rRNA
10. What are the rules for base-pairs
a. A with G b. A with T c. A with C d. G with U

DNA / RNA REPLICATION GLOSSARY

- Frame-shift Mutation:** *The addition (insertion mutation) or removal (deletion mutation) of one or more nucleotides that is not indivisible by three, therefore resulting in a completely different amino acid sequence than would be normal. The earlier in the sequence nucleotides are added or removed, the more altered the protein will be.*
- Mutation:** *A permanent transmissible change of genetic material (e.g., chromosomal mutations and gene mutations).*
- Point Mutation:** *A single-base substitution causing the replacement of a single-base nucleotide with another nucleotide (e.g., silent mutation, in which there is no change in an amino acid; missense mutation, in which there is a different amino acid; and nonsense mutation, in which there is an insertion of a stop codon in the amino acid which stops protein synthesis).*
- Protein Synthesis:** *The process in which amino acids are arranged in a linear sequence through the processes of transcription of DNA and to RNA and the translation of RNA to a polypeptide chain.*
- Semiconservative Replication:** *The process in which the DNA molecule uncoils and separates into two strands. Each original strand becomes a template on which a new strand is constructed, resulting in two DNA molecules identical to the original DNA molecule.*
- Transcription:** *The process in which a strand of messenger RNA (mRNA) is synthesized by using the genetic information found on a strand DNA as a template.*
- Translation:** *The process in which the messenger RNA (mRNA) molecule on a ribosome is decoded to produce a sequence of amino acids for protein synthesis.*
- Translocation:** *The process in which a segment of a chromosome breaks off and attaches to another chromosome.*

UNIT 6: GENETICS

ASSESSMENT ANCHOR BIO.B.2 Genetics		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.B.2.1 Compare Mendelian and non-Mendelian patterns of inheritance.	BIO.B.2.1.1 Describe and/or predict observed patterns of inheritance (i.e., dominant, recessive, co-dominance, incomplete dominance, sex-linked, polygenic, and multiple alleles).	3.1.B.B5

Sample Exam Question

Standard BIO.B.2.1.1

Use the table below to answer the question.

Blood Types

Genotype(s)	Phenotype
ii	O
I ^A I ^A , I ^A i	A
I ^B I ^B , I ^B i	B
I ^A I ^B	AB

Blood type is inherited through multiple alleles, including I^A, I^B, and i. A child has type A blood. If the father has type AB blood, what are all the possible phenotypes of the mother?

- A. phenotypes O or A
- B. phenotypes A or AB
- C. phenotypes A, B, AB
- D. phenotypes O, A, B, AB

ASSESSMENT ANCHOR**BIO.B.2 Genetics (*continued*)**

Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.B.2.1 Compare Mendelian and non-Mendelian patterns of inheritance.	BIO.B.2.1.1 Describe and/or predict observed patterns of inheritance (i.e., dominant, recessive, co-dominance, incomplete dominance, sex-linked, polygenic, and multiple alleles).	3.1.B.B5

Sample Exam Question**Standard BIO.B.2.1.1**

A cattle farmer genetically crosses a cow (female) with a white coat with a bull (male) with a red coat. The resulting calf (offspring) is roan, which means there are red and white hairs intermixed in the coat of the calf. The genes for coat color in cattle are co-dominant.

Part A: Although a farm has cattle in all three colors, the farmer prefers roan cattle over white or red cattle. Use the Punnett square to show a cross that would produce only roan offspring.

		_____	_____

Part B: Explain how a roan calf results from one white- and one red-coated parent. In your explanation, use letters to represent genes. Be sure to indicate what colors the letters represent.

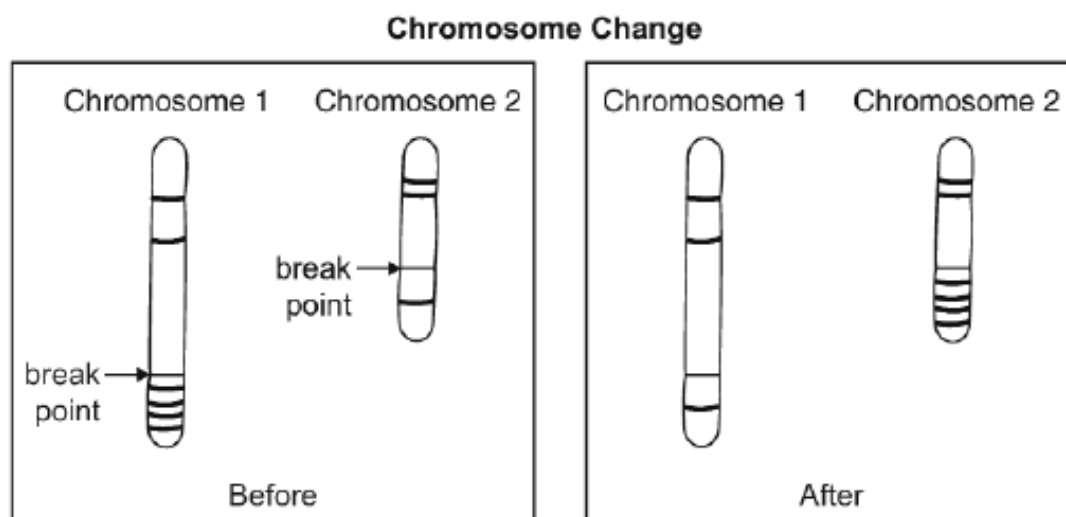
Part C: Predict the possible genotypes and phenotypes of the offspring produced from two roan cattle.

ASSESSMENT ANCHOR**BIO.B.2 Genetics (*continued*)**

Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.B.2.1 Compare Mendelian and non-Mendelian patterns of inheritance.	BIO.B.2.1.2 Describe processes that can alter composition or number of chromosomes (i.e., crossing-over, nondisjunction, duplication, translocation, deletion, insertion, and inversion).	3.1.B.B1 3.1.B.B2 3.1.B.B3 3.1.C.C2

Sample Exam QuestionStandard **BIO.B.2.1.2**

Use the diagram below to answer the question.



Which type of change in chromosome composition is illustrated in the diagram?

- A. deletion
- B. insertion
- C. inversion
- D. translocation

ASSESSMENT ANCHOR BIO.B.2 Genetics (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.B.2.2 Explain the process of protein synthesis (i.e., transcription, translation, and protein modification).	BIO.B.2.2.1 Describe how the processes of transcription and translation are similar in all organisms.	3.1.B.B1 3.1.B.B3 3.1.B.B5 3.1.C.B3 3.1.C.C2
	BIO.B.2.2.2 Describe the role of ribosomes, endoplasmic reticulum, Golgi apparatus, and the nucleus in the production of specific types of proteins.	3.1.B.A5 3.1.B.B3 3.1.B.B5 3.1.C.B3

Sample Exam Questions

Standard BIO.B.2.2.1

Which statement describes a cell process that is common to both eukaryotic and prokaryotic cells?

- A. Both cell types carry out transcription in the nucleus.
- B. Both cell types use ribosomes to carry out translation.
- C. Both cell types assemble amino acids to carry out transcription.
- D. Both cell types carry out translation in the endoplasmic reticulum.

Standard BIO.B.2.2.2

The endoplasmic reticulum is a network of membranes within the cell, and it is often classified as rough or smooth, depending on whether there are ribosomes on its surface. Which statement **best** describes the role of rough endoplasmic reticulum in the cell?

- A. It stores all proteins for later use.
- B. It provides an attachment site for larger organelles.
- C. It aids in the production of membrane and secretory proteins.
- D. It stores amino acids required for the production of all proteins.

ASSESSMENT ANCHOR BIO.B.2 Genetics (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.B.2.3 Explain how genetic information is expressed.	BIO.B.2.3.1 Describe how genetic mutations alter the DNA sequence and may or may not affect phenotype (e.g., silent, nonsense, frame-shift).	3.1.B.B1 3.1.B.B3 3.1.B.C2 3.1.C.B3 3.1.C.C2

Sample Exam Question

Standard BIO.B.2.3.1

A genetic mutation resulted in a change in the sequence of amino acids of a protein, but the function of the protein was not changed. Which statement **best** describes the genetic mutation?

- A. It was a silent mutation that caused a change in the DNA of the organism.
- B. It was a silent mutation that caused a change in the phenotype of the organism.
- C. It was a nonsense mutation that caused a change in the DNA of the organism.
- D. It was a nonsense mutation that caused a change in the phenotype of the organism.

ASSESSMENT ANCHOR BIO.B.2 Genetics (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.B.2.4 Apply scientific thinking, processes, tools, and technologies in the study of genetics.	BIO.B.2.4.1 Explain how genetic engineering has impacted the fields of medicine, forensics, and agriculture (e.g., selective breeding, gene splicing, cloning, genetically modified organisms, gene therapy).	3.1.B.B4 4.4.7.A 4.4.10.A 4.4.12.A 4.4.7.B 4.4.10.B 4.4.12.B

Sample Exam Question

Standard BIO.B.2.4.1

Genetic engineering has led to genetically modified plants that resist insect pests and bacterial and fungal infections. Which outcome would **most likely** be a reason why some scientists recommend caution in planting genetically modified plants?

- A. unplanned ecosystem interactions
- B. reduced pesticide and herbicide use
- C. improved agricultural yield and profit
- D. increased genetic variation and diversity

Mendelian and Human Genetics

Introduction

Gregor Mendel was a priest who worked in a monastery. He was responsible for maintaining the garden. As he bred pea plants, he noted important patterns about how the traits of the plant (he called them factors) were passed down. Mendel came up with important principles (to the right) to sum up his findings

Genetics is a complex field with lots of details to keep straight. But when you get a handle on some key terms and concepts, including the structure of DNA and the laws of inheritance, you can start putting the pieces together for a better understanding of genetics.

Mendel's Principles of Inheritance

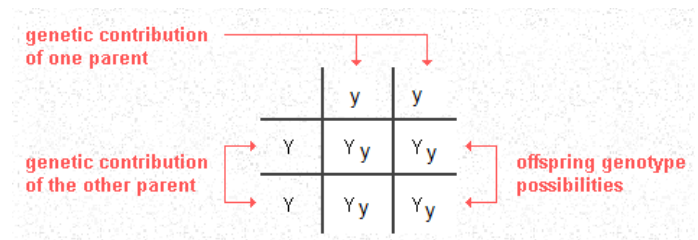
- Inherited traits are transmitted by genes which occur in alternate forms called alleles
- **Principle of Dominance** - when 2 forms of the same gene are present the dominant allele is expressed
- **Principle of Segregation** - in meiosis two alleles separate so that each gamete receives only one form of the gene
- **Principle of Independent Assortment** - each trait is inherited independent of other traits (chance)

The Scientific Language of Genetics

From chromosomes to DNA to dominant and recessive alleles, learning the language of genetics is equivalent to learning the subject itself. The following key terms are guaranteed to appear frequently in your study of all things genetic:

- **Alleles:** Alternative forms of a gene
- **Autosomal chromosome:** A nonsex chromosome
- **Chromosome:** A linear or circular strand composed of DNA that contains genes
- **Diploid:** An organism with two copies of each chromosome
- **DNA:** Deoxyribonucleic acid; the molecule that carries genetic information
- **Dominant:** A phenotype or allele that completely masks the presence of the other, recessive allele in the heterozygote
- **Gene:** The fundamental unit of heredity; a specific section of DNA within a chromosome
- **Genotype:** The genetic makeup of an individual; the allele(s) possessed at a given locus
- **Heterozygote:** An individual with two different alleles of a given gene or locus
- **Homozygote:** An individual with two identical alleles of a given gene or locus
- **Locus:** A specific location on a chromosome
- **Phenotype:** The physical characteristics of an individual
- **Recessive:** A phenotype or allele exhibited only when homozygous

The Punnett Square is a tool used to predict the genotypes and phenotypes of offspring. Punnett Squares have the parent gametes on the outside, and the products of fertilization are shown on the inside. This square only shows one trait, so it is for a **monohybrid** cross. These are probabilities, not guarantees.



Uncover Inheritance Based on Genotype and Phenotype Ratios

When solving genetics problems, it pays to know what patterns to look for. The parent genotypes and offspring phenotypic ratios in this table can help you figure out what kind of inheritance is at work.

Parent Genotypes	Offspring Phenotypic Ratio
Aa x Aa	3 A_ : 1 aa

Type of Inheritance
Simple dominance, monohybrid cross

Aa x Aa

1 AA : 2 Aa : 1 aa

Incomplete dominance

AaBb x AaBb

9 A_B_ : 3 A_bb : 3 aaB_ : 1 aabb

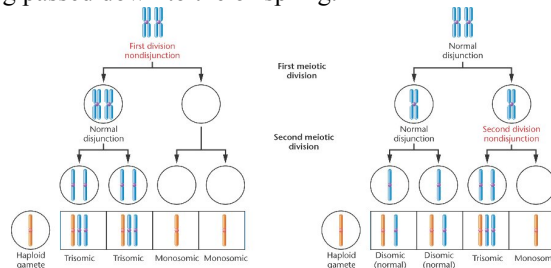
Dihybrid cross

Genetics: Understanding Chromosome Disorders

CHROMOSOMAL ABNORMALITIES

Chromosomal abnormalities, in the form of nondisjunction, are very common among humans. It's estimated that up to half of all miscarriages are due to some form of chromosome disorder. Sex chromosome disorders are the most commonly observed type of aneuploidy in humans, because X-chromosome inactivation allows individuals with more than two X chromosomes to compensate for the extra "doses" and survive the condition.

Nondisjunction occurs when chromosomes fail to separate evenly during either Meiosis I or Meiosis II. This results in the incorrect number of chromosomes being passed down to the offspring.



Three common categories of nondisjunction results crop up in humans:

- **Monosomy:** Occurs when one chromosome lacks its homolog. (EX Turner's syndrome [45 X])
- **Trisomy:** Occurs when one extra copy of a chromosome is present. (EX: Trisomy 21—Down's syndrome...3 copies of the 21st chromosome)(EX: Klinefelters...3 copies of sex chromosomes [47 XXY])
- **Polyploid:** Occurs when an entire extra set of chromosomes is present. This is fatal in animals, but fine for plants (EX: Strawberries are Octoploid..they have 8 sets instead of 2)

Most chromosome conditions are referred to by category of aneuploidy followed by the number of the affected chromosome. For example, trisomy 13 means that three copies of chromosome 13 are present.

POINT ABNORMALITIES

Sometimes mutations occur on a much smaller scale that cause genetic disorders. Below is a list of genetic diseases. **Autosomal** diseases are not linked to a gender, they are on chromosomes 1-22. **Sex-linked** traits are found on the X chromosome and tend to be present more in males (who only have one X, so they cannot mask a negative recessive trait with a second X)

Disease	Type	Effects
Sickle-cell anemia	Autosomal recessive	Changes shape of RBCs; not as good at picking up O ₂
Color-blindness	Sex-linked	Difficulty discerning certain shades of color
Huntingdon's disease	Autosomal dominant	Degrades nerve cells, leads to muscle and cognitive problems

DETECTING ABNORMALITIES

The use of **pedigrees** (left) and **karyotypes** (right) can be helpful in determining how a genetic disease is being passed down or if a person has a genetic disease.

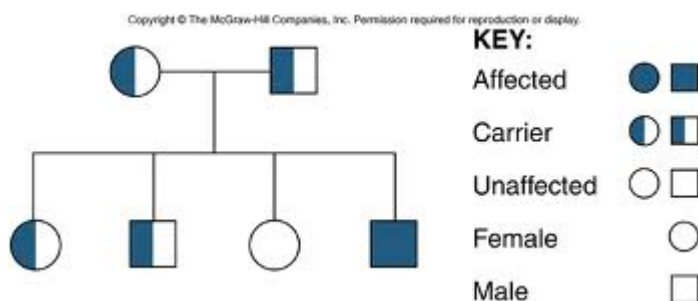
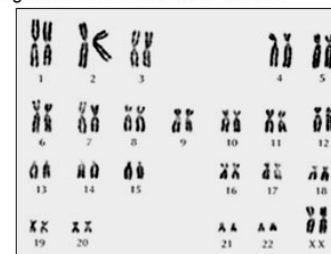


Figure B-10: The Human Genome



A person's 23 chromosomes, when all lined up, might look something like this. Each number in the diagram labels two copies of each chromosome: one from the father and one from the mother. Note that chromosome 23 (the sex chromosome) is labelled with two X's. This particular sample of DNA thus comes from a female.

Genetics

Please use the link below to guide you

<https://docs.google.com/file/d/0By3MFJ-zJlsYZ253dEg3ZXJ5Yms/edit>

1. Match the vocab terms to their definitions.

_____ Dominant allele	A. Organism with two different alleles for the same trait
_____ F1 generation	B. Genetic makeup
_____ F2 generation	C. Parental generation
_____ Genotype	D. Physical characteristics
_____ Gregor Mendel	E. Organism that has two identical alleles for a trait
_____ Heterozygous	F. Tool that can predict and compare genetic variation
_____ Homozygous	G. Allele that can be masked
_____ P generation	H. Priest who worked with garden peas
_____ Phenotype	I. First offspring generation
_____ Punnett Square	J. Allele that can mask other alleles
_____ Recessive allele	K. Second offspring generation

2. A monohybrid cross looks at _____ trait, while a dihybrid cross looks at _____ traits at the same time.

3. What is Mendel's idea of

- a. Dominance?
- b. Segregation?
- c. Independent Assortment?

4. When the dominant allele does not completely mask the recessive allele, it is called _____ dominance.

- a. What are two examples?

5. When both alleles show up together (one is not really dominant over the other), it is called _____.

- a. What are two examples?

6. Sex-linked traits are those found on the _____ chromosome, and show up more in (circle one) **males** / **females**

7. What is genetic engineering?

- a. Pros?

- b. Cons?



Keystone Pre-Test

The questions in this quiz refer to: Genetics

1. The allele that can be masked is called
a. homozygous b. co-dominant c. recessive d. heterozygous
2. The genotype AA or bb would be referred to as ____, while Aa or Bb would be ____.
a. recessive...dominant b. dominant...recessive c. heterozygous...homozygous
d. homozygous...heterozygous
3. A man with straight hair and a woman with curly hair have a child. The child has wavy hair. This would be an example of
a. incomplete dominance b. complete dominance c. co-dominance d. epistasis
4. Directly manipulating the genome of an organism is referred to as
a. genetic engineering b. playing god c. natural selection d. artificial evolution
5. A trait that is found on the X chromosome is referred to as
a. nondisjunction b. a homozygous disorder c. sex-linked d. autosomal
6. A man who is colorblind mates with a woman that is a carrier for colorblindness. What is the probability that they will have a colorblind child??
a. 25% b. 50% c. 75% d. 33%
7. The physical appearance of an organism that results from its genetic makeup is known as its?
a. genotype b. phenotype c. mitochondrial effect d. allele
8. Which of the following results in genetic variation
a. mitosis b. independent assortment c. metaphase d. symbiosis
9. When setting up a Punnett square, what information goes on the outside?
a. the offspring alleles b. the parent alleles c. the diploid chromosomes d. somatic cells
10. Different versions of the same trait are referred to as
a. alleles b. flavor c. somatic cells d. gametes

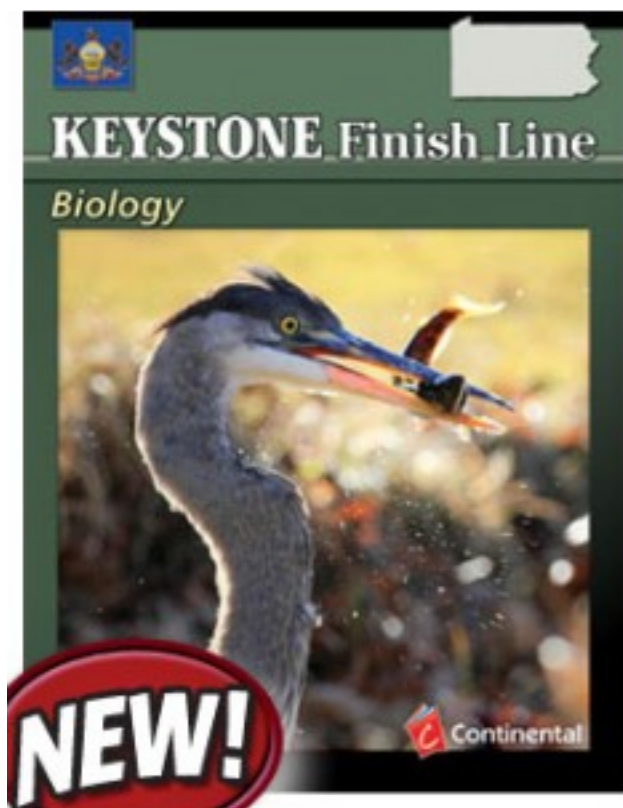
GENETICS GLOSSARY

- Allele:** *A variation of a gene's nucleotide sequence (an alternative of a gene).*
- Biotechnology:** *Any procedure or methodology that uses biological systems or living organisms to develop or modify either products or processes for specific use. This term is commonly associated with genetic engineering, which is one of many applications.*
- Cloning:** *a process in which a cell, cell product, or organism is copied from an original source (e.g., DNA cloning, - the transfer of a DNA fragment from one organism to a self-replicating genetic element such as a bacterial plasmid; reproductive cloning - the transfer of genetic material from the nucleus of a donor adult cell to an egg cell that has had its nucleus removed for the purpose of creating an embryo that can produce an exact genetic copy of the donor organism; or therapeutic cloning - the process of taking undifferentiated embryonic cells [STEM cells] for use in medical research).*
- Co-dominance:** *A pattern of inheritance in which the phenotypic effect of two alleles in a heterozygous genotype express each phenotype of each allele fully and equally; a phenotype which would not be expressed in any other genotypic combination.*
- Dominant Inheritance:** *A pattern of inheritance in which the phenotypic effect of one allele is completely expressed within a homozygous and heterozygous genotype.*
- Gene:** *A sequence of nucleotides composing a segment of DNA that provides a blueprint for a specific hereditary trait.*
- Gene Expression:** *The process in which a nucleotide sequence of a gene is used to make a functional product such as protein or RNA.*
- Gene Recombination:** *A natural process in which a nucleic acid molecule (usually DNA but can be RNA) is broken and then joined to a different molecule; a result of crossing-over.*
- Gene Splicing:** *A type of gene recombination in which the DNA is intentionally broken and recombined using laboratory techniques.*
- Gene Therapy:** *The intentional insertion, alteration, or deletion of genes within an individual's cell and tissues for the purpose of treating a disease.*
- Genetic Drift:** *A change in the allele frequency of a population as a result of chance events rather than natural selection.*
- Genetic Engineering:** *A technology that includes the process of manipulating or altering the genetic material of a cell resulting in desirable functions or outcomes that would not occur naturally.*
- Genetically Modified Organism:** *An organism whose genetic material has been altered through some genetic engineering technology or technique.*
- Genetics:** *The scientific study of inheritance.*

- Genotype:** *The genetic composition of an organism with reference to a single trait, a set of traits, or the entire complement of traits of an organism.*
- Incomplete Dominance:** *A pattern of inheritance in which two alleles, inherited from the parents, are neither dominant nor recessive. The resulting offspring have a phenotype that is a blending of the parental traits.*
- Inheritance:** *The process in which genetic material is passed from parents to their offspring.*
- Migration (Genetics):** *The permanent movement of genes into or out of a population resulting in a change in allele frequencies.*
- Multiple Alleles:** *More than two forms of a gene controlling the expression of a trait.*
- Phenotype:** *The observable expression of a genotype.*
- Polygenic Trait:** *A trait in which the phenotype is controlled by two or more genes at different loci on different chromosomes.*
- Recessive inheritance:** *A pattern of inheritance in which the phenotypic effect of one allele is only expressed within a homozygous genotype. In a heterozygous condition with a dominant allele, it is not expressed in the phenotype.*
- Selective Breeding:** *The process of breeding organisms that results in offspring with desired genetic traits.*
- Sex-linked Trait:** *A trait, associated with a gene that is carried by either the male or female parent (e.g., color blindness and sickle-cell anemia).*

Constructed Response Questions

Subject	Biology
Unit Name	Genetics
<p>Genes exert their influence on organisms by being turned on and off in precise ways and at precise times. Disease can result when problems arise during this process of “gene regulation.” The first processes of gene regulation to be discovered involved molecular ‘switches’ that regulate transcription at gene promoters. In the last 20 years, genomic research has uncovered many new types of gene regulation that earlier researchers would have never imagined. Genes can be regulated by repressors, activators, enhancers, epigenetic changes to chromatin, RNA interference, the environment, and other processes.</p> <ul style="list-style-type: none"> Choose one of the gene regulation processes listed above and, using references to support your argument, explain why/how that regulatory process is critically important to ONE of the following: <ul style="list-style-type: none"> early development normal cell function causation of disease or cell malfunction 	
<p>Scientists can now determine the complete DNA sequences of organisms, including humans.</p> <ul style="list-style-type: none"> Now that this milestone has been reached, is there a reason to continue learning about Mendel, alleles, and inheritance patterns? Explain your answer. If you were a genetics researcher, what would you like to study and why? 	
<p>In 2010, a major discovery in genetics research found that the DNA of some modern humans contains small amounts of Neanderthal DNA.</p> <ul style="list-style-type: none"> Briefly explain the relevance of this finding to human ancestry and evolution. Do you think that we have any traits of other lines of human ancestry? Explain. 	
<p>Stem cell research has been in the press frequently in the last several years.</p> <ul style="list-style-type: none"> Discuss the practical implications that genetics research is playing in our lives today. Discuss where it might lead us in the next 10 years. 	
<p>Some traits come in two varieties (for example, Mendel’s round and wrinkled peas with the green and yellow colors).</p> <ul style="list-style-type: none"> Do all traits for all species come in only two varieties? Justify your answer by explaining the relationship between genes and traits. Discuss your own personal traits and give examples of those that are inherited and those that are learned. 	
<p>In humans, sex linked recessive disorders such as color blindness occur more frequently in males than females.</p> <ul style="list-style-type: none"> Create a Punnett Square which shows the cross between a female carrier for color blindness and a normal male. Referring to the Punnett Square created; explain how it is less likely that females suffer from sex linked recessive disorders. 	
<p>Changes in DNA are called mutations.</p> <ul style="list-style-type: none"> Describe the importance of repair enzymes in the replication of DNA Why do you think it will be unlikely for a particular mutation to have a noticeable effect on a population? 	



LESSON 1: GENES AND INHERITANCE	P 131 - 140
LESSON 2: MUTATIONS AND CHROMOSOMES ABNORMALITIES	
.....	P 141 - 147
LESSON 3: GENETIC ENGINEERING	P 148 - 159

UNIT 7: THEORY OF EVOLUTION

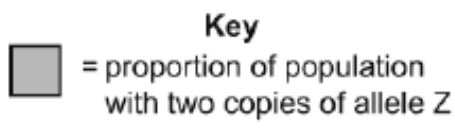
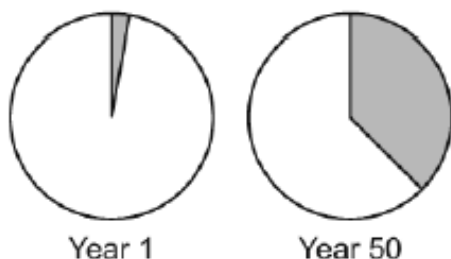
ASSESSMENT ANCHOR		
BIO.B.3 Theory of Evolution		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.B.3.1 Explain the mechanisms of evolution.	BIO.B.3.1.1 Explain how natural selection can impact allele frequencies of a population.	3.1.B.C1
	BIO.B.3.1.2 Describe the factors that can contribute to the development of new species (e.g., isolating mechanisms, genetic drift, founder effect, migration).	3.1.B.C1 3.1.B.C2
	BIO.B.3.1.3 Explain how genetic mutations may result in genotypic and phenotypic variations within a population.	3.1.B.C2 3.1.B.B1

Sample Exam Questions

Standard BIO.B.3.1.1

Use the circle graphs below to answer the question.

Changes in Allele Frequency Over Time



The graphs illustrate change in a lizard population over time. Which process **most likely** led to the change in the lizard population?

- A. natural selection acting on a harmful trait
- B. natural selection acting on a beneficial trait
- C. natural selection acting on a dominant trait
- D. natural selection acting on a recessive trait

Standard BIO.B.3.1.2

In North America, the eastern spotted skunk mates in late winter, and the western spotted skunk mates in late summer. Even though their geographic ranges overlap, the species do not mate with each other. What **most likely** prevents these two species from interbreeding?

- A. habitat isolation
- B. gametic isolation
- C. geographic isolation
- D. reproductive isolation

Standard BIO.B.3.1.3

A mutation occurs in the genes that code for coat color in deer. Which change will **most likely** result from this mutation?

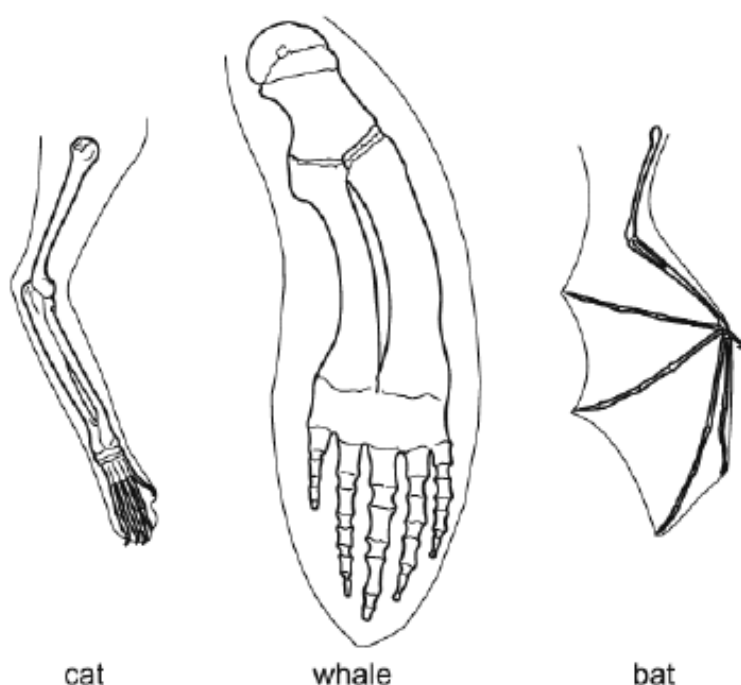
- A. a change in the selection pressures acting on coat color
- B. a change in the coat-color genes of deer predator species
- C. an increase in coat-color diversity in the population
- D. an increase in the number of genes for coat color in the population

ASSESSMENT ANCHOR**BIO.B.3 Theory of Evolution (*continued*)**

Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.B.3.2 Analyze the sources of evidence for biological evolution.	BIO.B.3.2.1 Interpret evidence supporting the theory of evolution (i.e., fossil, anatomical, physiological, embryological, biochemical, and universal genetic code).	3.1.B.C3 3.1.B.C1 3.1.B.B3

Sample Exam QuestionStandard **BIO.B.3.2.1**

Use the illustrations below to answer the question.

Mammalian Forelimbs

The skeletons of mammalian forelimbs represent variations of a structure that was present in their common ancestor. What has **most likely** caused the variation in forelimbs?

- A. changes in muscle structure
- B. changes in the genetic codes
- C. trait formation due to behaviors
- D. development of vestigial structures

ASSESSMENT ANCHOR BIO.B.3 Theory of Evolution (<i>continued</i>)		
Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.B.3.2 Analyze the sources of evidence for biological evolution.	BIO.B.3.2.1 Interpret evidence supporting the theory of evolution (i.e., fossil, anatomical, physiological, embryological, biochemical, and universal genetic code).	3.1.B.C3 3.1.B.C1 3.1.B.B3

Sample Exam Question

Standard BIO.B.3.2.1

Use the table below to answer the question.

Sequence Differences between
COLL Genes in Some Animals

Animal	Number of Base Differences from a Rat
mouse	101
cow	136

The gene COLL is in the genome of many organisms. A comparison of the number of base differences between the COLL gene in a rat and that of two other animals is shown.

Part A: Based on the data, describe a possible evolutionary relationship between rats, mice, and cows.

Part B: Describe how different organisms having a common gene such as COLL supports the theory of evolution.

Part C: The COLL gene of a monkey has 203 base differences from the same gene in a rat and 210 base differences from the same gene in a mouse. Compare the evolutionary relationships between the monkey, the rat, and the mouse.

ASSESSMENT ANCHOR**BIO.B.3 Theory of Evolution (*continued*)**

Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.B.3.3 Apply scientific thinking, processes, tools, and technologies in the study of the theory of evolution.	BIO.B.3.3.1 Distinguish between the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation.	3.1.B.A9

Sample Exam QuestionStandard **BIO.B.3.3.1**

Use the table below to answer the question.

Student's Observations of a Pond Ecosystem

Quantitative	Qualitative
37 fish and 3 frogs	Leaves lie on the bottom of the pond.
2 types of aquatic grass	Water insects move along the water's surface.
12 small rocks and 1 medium rock	All 3 frogs are sitting on a pond bank.
sand	

A group of students measured a ten-square-meter section of a pond ecosystem and recorded observations. Which statement is a testable hypothesis?

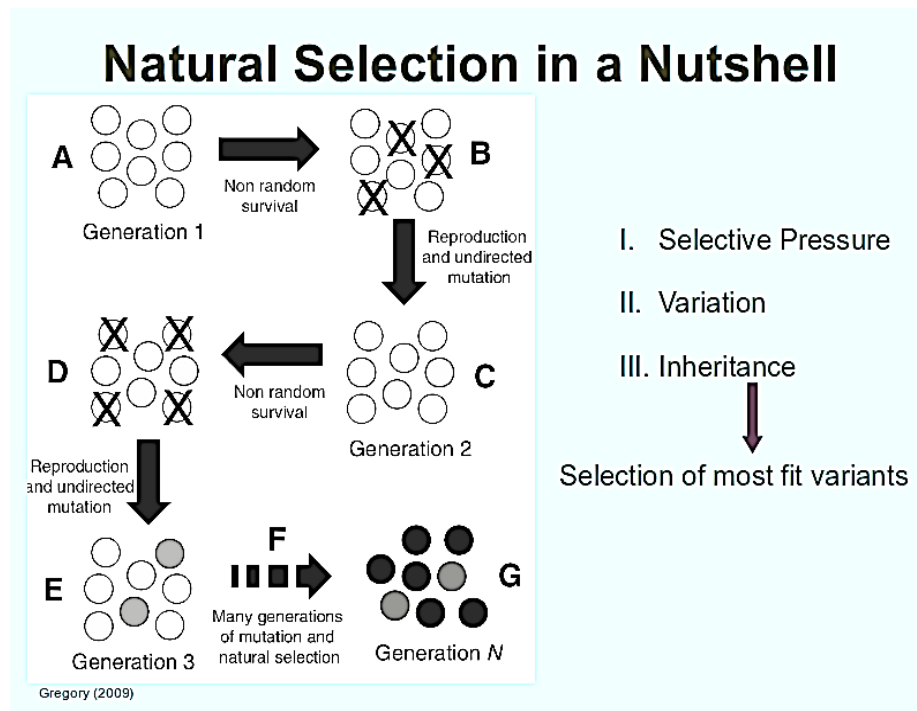
- A. The frogs living in the pond represent a population.
- B. Water is an abiotic component in the pond ecosystem.
- C. If the fish are given more food, then they will be happier.
- D. If the frogs are startled, then they will jump into the water.

Evolution

Mechanism for Evolution

Charles Darwin concluded that biological evolution occurs as a result of natural selection, which is the theory that in any given generation, some individuals are more likely to survive and reproduce than others. In order for natural selection to occur in a population, several conditions must be met:

- **Individuals in the population must produce more offspring than can survive.** Human beings are somewhat unique among living things in that we can make conscious choices about how many offspring we have. Most other organisms, however, produce as many offspring as they can.
- **Those individuals must have different characteristics.** During Darwin's time, no one knew where these differences came from. Now scientists know that differences in organisms arise due to mutations in [DNA](#) combined with the mixing of genetic information during sexual reproduction.
- **Offspring must inherit some characteristics from their parents.** During Darwin's time, the laws of inheritance were just beginning to be figured out, so Darwin didn't know exactly how parents passed on their traits. Modern scientists know that traits are inherited when parents pass genes on to their offspring.
- **Organisms with the best-suited characteristics for their environment are more likely to survive and reproduce.** This is the heart of natural selection. If there's competition for survival and not all the organisms are the same, then the ones with the advantageous traits are more likely to survive. If these traits can be inherited, then the next generation will show more of these advantageous traits.



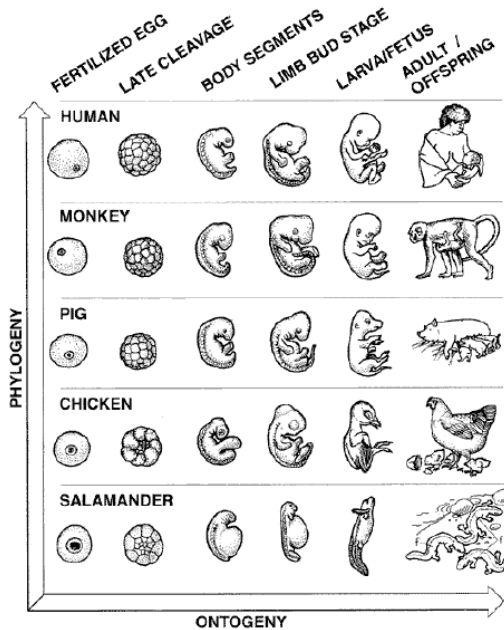
If these four conditions are met, then the new generation of individuals will be different from the original generation in the frequency and distribution of traits, which is pretty much the definition of biological evolution.

In addition, two other factors affect the genetic variability of a species

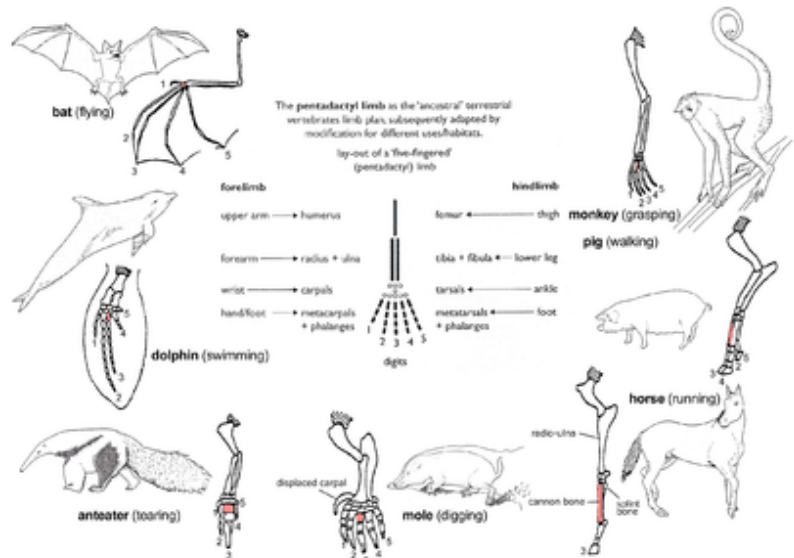
- **Genetic drift:** Either through a bottleneck (population crashes and greatly reduces number and diversity of population) or the founder effect (small group leaves to start anew...reduces number and diversity of population); the "new" population does not have the same frequencies or amounts of traits that were previously in the larger population
- **Gene flow:** organisms of the same species are able to move back and forth between areas to increase the variation of the population through sexual reproduction.

Evidence for Evolution

Previously, the main evidence for evolution was based on **anatomy** (structures) or **physiology** (functions) of organisms. Currently, comparing **biochemical evidence** (DNA, RNA, or protein sequences) provides scientists with the most detailed information. In general, the more similarities two organisms share, the more recently they diverged from a common ancestor.



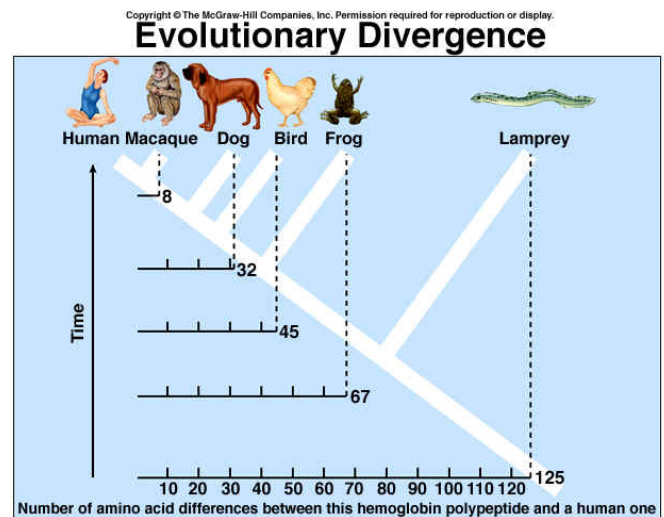
EMBROLOGY compares the embryos of different species. The similar development patterns of the species above indicates that they shared a common ancestor



HOMOLOGOUS STRUCTURES are structures that have the same shape/form, but are used differently. The bones in the center are from the common ancestor, but each species has evolved to use them differently

		Fore foot	Hind foot	Molar teeth
Recent				
Pleistocene		One Toe Splint of 3 rd and 4 th digits	One Toe Splint of 3 rd and 4 th digits	Long-Crowned, Crescent-shaped
Pliocene		Three Toes Side toes not touching the ground	Three Toes Side toes not touching the ground	
Miocene		Three Toes Side toes touching the ground, splint of 3 rd digit	Three Toes Side toes touching the ground	
Oligocene		Four Toes		Short-Crowned, without Crescent
Eocene		Four Toes Splint of 1 st digit	Three Toes Splint of 3 rd digit	

FOSSIL EVIDENCE links present day organisms to the common ancestors. Here we see the bones of modern horses (top) and how much it has changed from common ancestors (bottom)



BIOCHEMICAL EVIDENCE compares the differences in either DNA or proteins (in this case, proteins). The lamprey has the most differences from humans, which indicates we diverged from the lampreys (are less related) much longer ago than the macaques (more related)

Not shown are **vestigial structures**, which are structures reduced in size that are no longer needed but were present in a common ancestor (think of the human tail bone or wisdom teeth. In addition, whales have tiny little hip bones but no legs, which suggests that that the ancestor of the whale walked on land and returned to the sea!). Also not shown are **analogous structures**, which are structures that look the same but are made out of different materials. This shows that species have changed to adapt to the environment in a similar manner.

ASSESSMENT ANCHOR**BIO.B.4 Ecology**

Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.B.4.1 Describe ecological levels of organization in the biosphere.	BIO.B.4.1.1 Describe the levels of ecological organization (i.e., organism, population, community, ecosystem, biome, and biosphere).	4.1.4.A 4.1.7.C 4.1.7.A 4.4.6.A 4.1.10.A 4.5.3.D
	BIO.B.4.1.2 Describe characteristic biotic and abiotic components of aquatic and terrestrial ecosystems.	4.1.7.A 4.1.4.C 4.1.3.A 4.4.5.C 4.1.4.B 4.4.3.C 4.2.10.A

Sample Exam Questions**Standard BIO.B.4.1.1**

Use the list below to answer the question.

Observations

- two grey wolves
- five moose
- several species of conifer trees
- large granite rock
- shallow pond

A student wrote several observations in a field notebook. Which term **best** classifies all of the student's observations?

- A. population
- B. food chain
- C. ecosystem
- D. community

Standard BIO.B.4.1.2

A researcher observing an ecosystem describes the amount of sunlight, precipitation, and type of soil present. Which factors is the researcher **most likely** describing?

- A. biotic factors in a forest
- B. biotic factors in a tundra
- C. abiotic factors in a prairie
- D. abiotic factors in an ocean

Evolution

Please use the link below to guide you

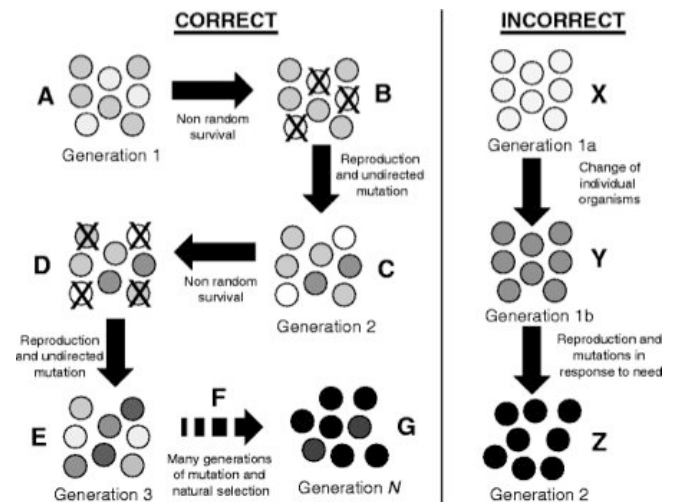
<https://docs.google.com/file/d/0By3MFJ-zJlsYaHNsN0NoemFCQWs/edit>

1. A process in which new species develop from pre-existing species is known as _____.
2. TRUE or FALSE: There are always enough resources to support all organisms: _____
3. What happens to the species that have the advantageous traits?
 - a. _____
 - b. _____
4. What happens to the species that do NOT have advantageous traits?

5. Explain why the INCORRECT section on the right IS incorrect

6. What are the three different types of isolating mechanisms?

- a. _____
- b. _____
- c. _____



7. A decrease in genetic variation caused by the formation of a new population by a small number of individuals from a larger population is known as _____.
8. Describe the following pieces of evidence for evolution
 - a. Fossils: _____
 - b. Homologous structures: _____
 - c. Analogous structures: _____
 - d. Embryology: _____
 - e. Biochemistry: _____
9. What happens during gradualism? _____
10. What happens during punctuated equilibrium? _____
11. Give an example of
 - a. Selective breeding: _____
 - b. Inbreeding: _____
 - c. Hybridization: _____

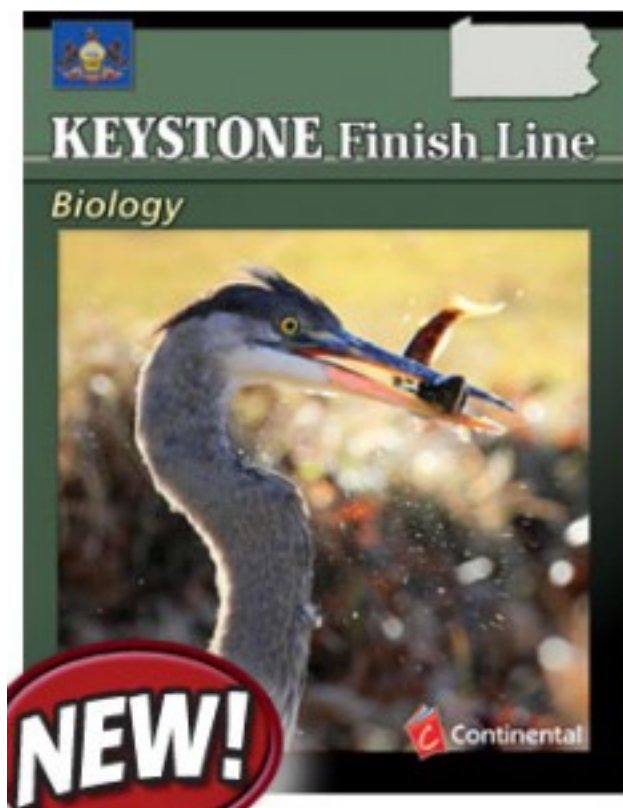
Keystone Pre-Test

The questions in this quiz refer to: Evolution

1. Which would an animal breeder use to produce cows that give more milk?
a. Genetic isolation b. Artificial selection c. Overproduction d. Acquired characteristics
2. A slow and steady evolutionary change in species is known as
a. extinction b. punctuated equilibrium c. gradualism d. extantism
3. The arm bones of a cat, a bat, and a human would be an example of
a. coevolutionary structures b. vestigial structures c. analogous structures
d. homologous structures
4. Remains of organisms that are preserved and can show evolutionary relationships are known as
a. disruptive selection b. fossils c. missing links d. stabilization
5. Where does variation in organisms come from?
a. the environment b. mutations c. future generations d. Metaphase II
6. A variation that allows an organism to better survive in its environment is known as a(n)?
a. variation b. reductive trait c. adaptation d. gradualism
7. The theory of evolution is driven by the process of
a. natural selection b. artificial selection c. stabilizing selection d. disruptive selection
8. Fish produce thousands of eggs every year. What part of Darwin's theory would this be?
a. overproduction b. competition c. survival d. variation
9. A earthquake divides two pieces of land. What type of isolation would this be?
a. genetic isolation b. behavioral isolation c. temporal isolation d. geographical isolation
10. Mating with relatives is known as
a. inbreeding b. outcrossing c. random mating d. polygenic effect

Constructed Response Questions

Subject	Biology
Unit Name	Evolution
<p>Evolution is the change in a species over a period of time.</p> <ul style="list-style-type: none"> • Discuss 3 factors that affect the evolutionary process. Explain in detail. • What would happen if organisms were not able to adapt to their environment? 	
<p>The Theory of Evolution by Natural Selection was proposed by Charles Darwin, which replaced Lamarck's Theory of Acquired Characteristics.</p> <ul style="list-style-type: none"> • Discuss the similarities and difference of these two theories. • How does natural selection encourage inter-specific and intra-specific diversity over time? 	
<p>There is evidence that scientists feel support Darwin's Theory of Evolution.</p> <ul style="list-style-type: none"> • What is the scientific evidence that supports Darwin's Theory of Evolution? • What traits do you have that you would like to evolve? Explain your reasoning. 	
<p>As the field of science has advanced over the years, the introduction and implementation of technology has assisted scientists in studying evolution and improved the quality of their findings.</p> <ul style="list-style-type: none"> • Identify, explain, and demonstrate how technology can be used to determine evolutionary relationships among species (Gel electrophoresis, DNA/amino acid sequences). • Do you feel that these methods are valid in studying evolutionary relationships? Explain your reasoning. 	
<p>Darwin wrote, <i>On the Origin of Species</i>, in which he argued that natural selection is the mechanism for evolution.</p> <ul style="list-style-type: none"> • Relate the roles of adaptation and fitness to the theory of natural selection. • Do you think that a characteristic not controlled by heredity can be controlled by natural selection? Explain your answer. 	



LESSON 1: MECHANISMS OF EVOLUTION P 159 – 168

LESSON 2: THE EVIDENCE FOR EVOLUTIONP 169 – 178

LESSON 3: SCIENTIFIC TERMINOLOGY P 179 – 186

EVOLUTION GLOSSARY

Evolution: *A process in which new species develop from preexisting species (biological evolution or macroevolution); a change in the allele frequencies of a population of organisms from generation to generation (genetic evolution or microevolution).*

Extinction: *A term that typically describes a species that no longer has any known living individuals.*

Fossils: *The preserved remains or traces of organisms that once lived on Earth.*

Founder Effect: *A decrease in genetic variation caused by the formation of a new population by a small number of individuals from a larger population.*

Gradualism: *A proposed explanation in evolutionary biology stating that new species arise from the result of slight modifications (mutations and resulting phenotypic changes) over many generations.*

Natural Selection: *A process in nature in which organisms possessing certain inherited traits are better able to survive and reproduce compared to others of their species.*

Punctuated Equilibrium: *A proposed explanation in evolutionary biology stating that species are generally stable over long periods of time. Occasionally there are rapid changes that affect some species which can quickly result in a new species.*

UNIT 8: ECOLOGY

ASSESSMENT ANCHOR

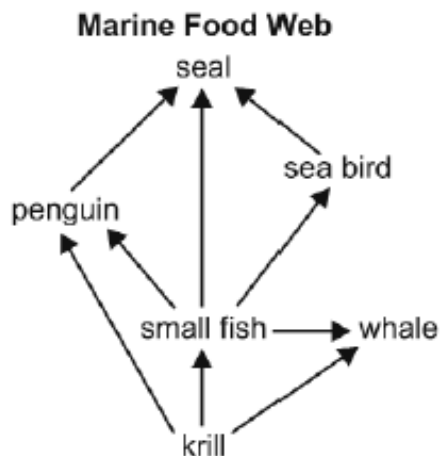
BIO.B.4 Ecology (*continued*)

Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.B.4.2 Describe interactions and relationships in an ecosystem.	BIO.B.4.2.1 Describe how energy flows through an ecosystem (e.g., food chains, food webs, energy pyramids).	4.1.4.C 4.1.3.C 4.1.7.C 4.1.5.C 4.1.10.C 4.1.5.A 4.1.12.C
	BIO.B.4.2.2 Describe biotic interactions in an ecosystem (e.g., competition, predation, symbiosis).	4.1.7.A 4.5.6.D 4.1.10.A 4.5.3.D

Sample Exam Questions

Standard BIO.B.4.2.1

Use the diagram below to answer the question.



Which sequence correctly describes the flow of energy between organisms in the marine food web?

- A. from seals to penguins to krill
- B. from whales to krill to small fish
- C. from sea birds to seals to penguins
- D. from small fish to penguins to seals

Standard BIO.B.4.2.2

A species of snapping turtles has a tongue that resembles a worm. The tongue is used to attract small fish. Which **best** describes the interaction between the fish and the snapping turtle?

- A. predation
- B. symbiosis
- C. parasitism
- D. competition

ASSESSMENT ANCHOR BIO.B.4 Ecology (<i>continued</i>)				
Anchor Descriptor		Eligible Content		Enhanced Standard
BIO.B.4.2	Describe interactions and relationships in an ecosystem.	BIO.B.4.2.3	Describe how matter recycles through an ecosystem (i.e., water cycle, carbon cycle, oxygen cycle, and nitrogen cycle).	4.1.4.B 4.4.3.C 4.1.7.B 4.5.4.C 4.2.5.A 4.5.8.C 4.2.7.A 4.3.4.D 4.3.12.A 3.1.B.A2

Sample Exam Question

Standard **BIO.B.4.2.3**

Which statement correctly describes how nitrogen in the soil returns to the atmosphere?

- A. Soil bacteria convert nitrates into nitrogen gas.
- B. Decomposers directly convert ammonium into nitrogen gas.
- C. Plants assimilate nitrites and convert them into nitrogen gas.
- D. Nitrogen-fixing bacteria in plant roots convert nitrates into nitrogen gas.

ASSESSMENT ANCHOR BIO.B.4 Ecology (<i>continued</i>)			
Anchor Descriptor		Eligible Content	Enhanced Standard
BIO.B.4.2 Describe interactions and relationships in an ecosystem.	BIO.B.4.2.4 Describe how ecosystems change in response to natural and human disturbances (e.g., climate changes, introduction of nonnative species, pollution, fires).		4.1.10.A 4.2.12.A
			4.1.10.B 4.2.10.B
			4.1.12.A 4.2.12.B
			4.1.4.A 4.2.10.C
			4.1.12.C 4.2.12.C
			4.1.4.E 4.3.12.A
			4.1.7.E 4.3.10.B
			4.1.10.E 4.5.10.B
			4.5.10.D 4.5.12.B
			4.2.8.A 4.5.4.C
			4.2.10.A 4.5.7.C

Sample Exam Question

Standard BIO.B.4.2.4

Agricultural runoff can carry fertilizers into lakes and streams. This runoff can cause algae populations to greatly increase. Which effect does this change in the algae population sizes **most likely** have on affected lakes and streams?

- A. an increase in water level
- B. an increase in water clarity
- C. a reduction in dissolved oxygen needed by fish and shellfish
- D. a reduction in temperature variations near the water's surface

ASSESSMENT ANCHOR BIO.B.4 Ecology (<i>continued</i>)				
Anchor Descriptor		Eligible Content		Enhanced Standard
BIO.B.4.2	Describe interactions and relationships in an ecosystem.	BIO.B.4.2.5	Describe the effects of limiting factors on population dynamics and potential species extinction.	4.1.4.A
				4.2.10.A
				4.1.10.A
				4.2.7.A
				4.1.12.A
				4.2.8.A
				4.1.7.E
				4.2.10.B
				4.1.10.E
				4.4.6.A
				4.1.4.E
				4.4.6.B
				4.2.10.C
				4.4.3.C
				4.5.3.D
				4.4.5.C
				4.5.5.D
				4.5.7.B
				4.5.6.D
				4.5.7.C
				4.5.10.D

Sample Exam Question

Standard BIO.B.4.2.5

A farmer observed that an increase in a field's soil nitrogen content was followed by an increase in producer productivity. What does this observation **most likely** indicate about the relationship between nitrogen and the producers in the field?

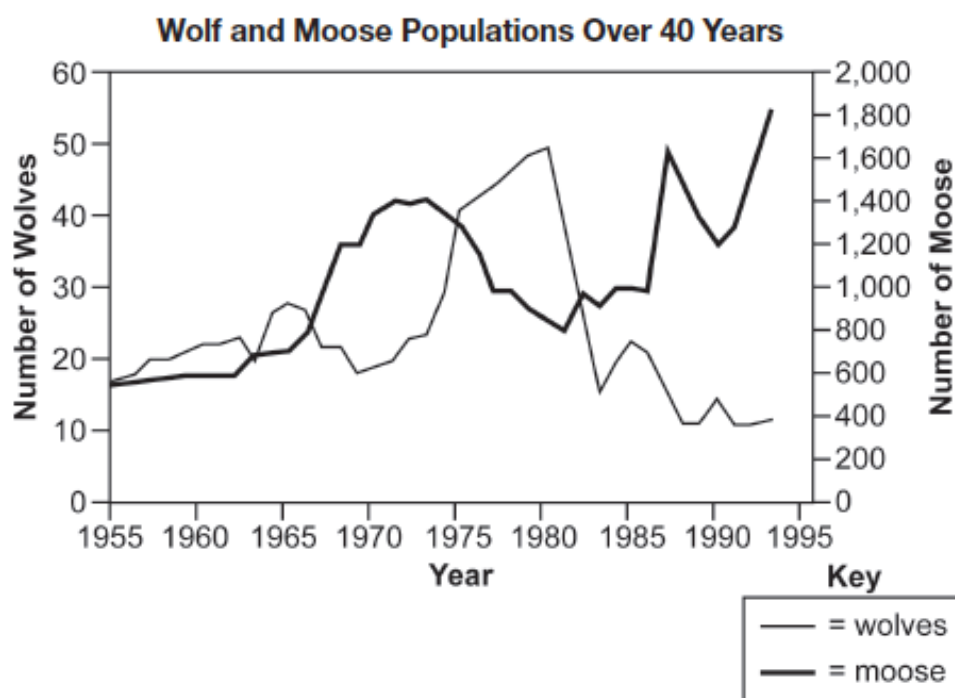
- A. Nitrogen was a biotic factor.
- B. Nitrogen was a limiting factor.
- C. Nitrogen became a surplus resource.
- D. Nitrogen became a selection pressure.

ASSESSMENT ANCHOR**BIO.B.4 Ecology (continued)**

Anchor Descriptor	Eligible Content	Enhanced Standard
BIO.B.4.2 Describe interactions and relationships in an ecosystem.	BIO.B.4.2.5 Describe the effects of limiting factors on population dynamics and potential species extinction.	4.1.4.A 4.2.10.A 4.1.10.A 4.2.7.A 4.1.12.A 4.2.8.A 4.1.7.E 4.2.10.B 4.1.10.E 4.4.6.A 4.1.4.E 4.4.6.B 4.2.10.C 4.4.3.C 4.5.3.D 4.4.5.C 4.5.5.D 4.5.7.B 4.5.6.D 4.5.7.C 4.5.10.D

Sample Exam QuestionStandard **BIO.B.4.2.5**

Use the graph below to answer the question.



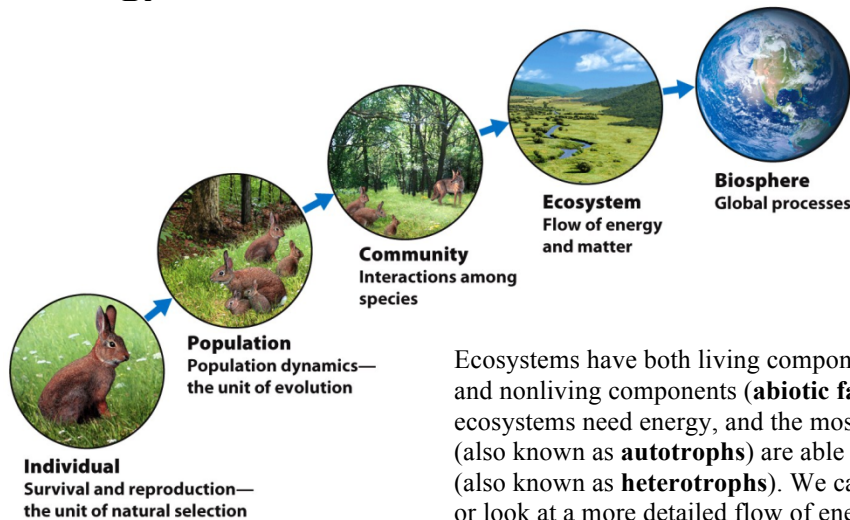
Isle Royale is located in Lake Superior. Isle Royale is home to populations of wolves and moose. The interactions between the wolves and moose, as well as the individual population sizes, have been studied since 1958. The graph shows the population sizes over time for both wolves and moose.

Part A: Describe one limiting factor for the moose population.

Part B: Explain one likely reason why the wolf population rapidly increased between 1975 and 1980.

Part C: Predict what will happen to the moose population's size after 1994 by describing the shape of the curve. In your answer, be sure to explain the reasoning behind your prediction.

Ecology

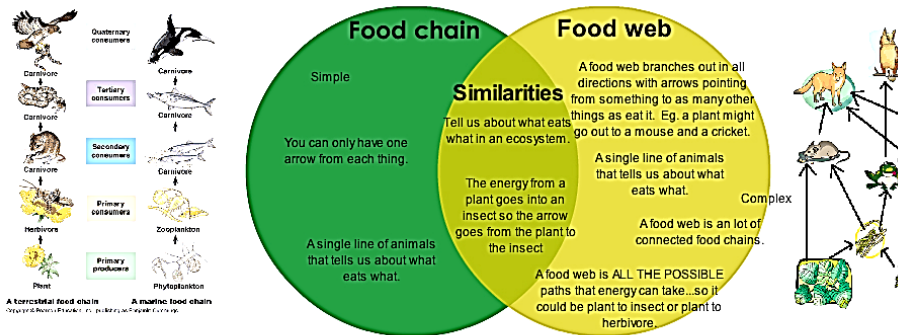


Ecology is the study of how organisms interact with their environment. There are many different levels of ecology. The diagram to the left shows all of the different levels

Ecosystems have both living components (**biotic factors** such as the trees, birds, and fish) and nonliving components (**abiotic factors** such as how much rain or sun an area gets). All ecosystems need energy, and the most basic form of energy comes from the sun. **Producers** (also known as **autotrophs**) are able to make their own food. These are eaten by **consumers** (also known as **heterotrophs**). We can track the flow of energy linearly using a **food chain** or look at a more detailed flow of energy using a **food web**.

Figure 6.1
Environmental Science
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What's the differences and similarities between Food Chains and Food Webs?



[online diagramming & design]

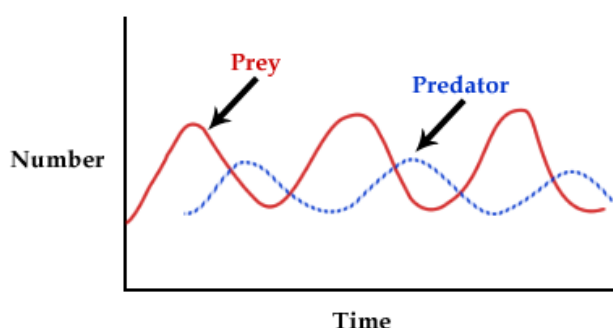
Organisms can interact with each other in many different ways.

Symbiosis is the general term for organisms that closely interact with each other. There are three different types of Symbiosis: parasitism, mutualism, and commensalism. The table to the right shows some of the different ways different organisms can interact with each other.

TABLE 6.2 Interactions between species and their effects		
Type of interaction	Species 1	Species 2
Competition	–	–
Predation	+	–
Mutualism	+	+
Commensalism	+	0

Table 6.2
Environmental Science
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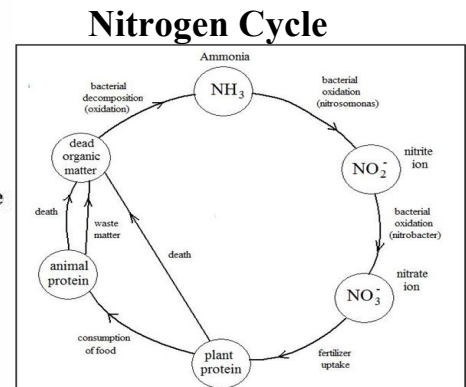
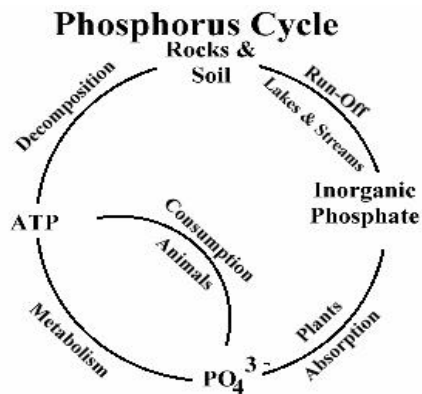
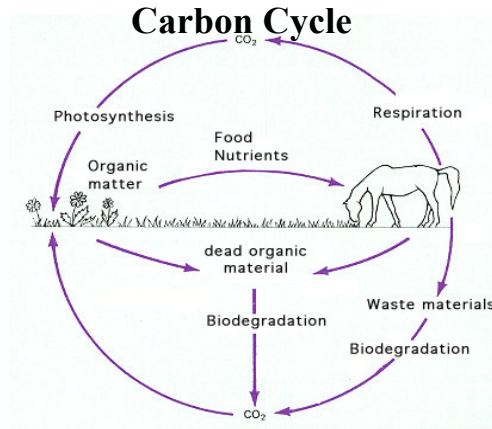
A **limiting factor** is some sort of factor (biotic or abiotic) that is going to limit the population's growth. It could be an important nutrient that is cycled through the ecosystem (such as water, nitrogen, carbon, or phosphorus), or it could be a food source or predator. A great example of limiting factors are predator-prey graphs. It is easy to see how the size of the population is affected.



Here, the size of the populations depends on the number of prey and predators. The predator population peaks after the prey population because of the lag time in reproduction. When the predator population is at its highest, the prey is at its lowest. With limited food, the population size of the predator decreases. This allows the prey population to increase, and the cycle continues again...

Nutrient Cycles

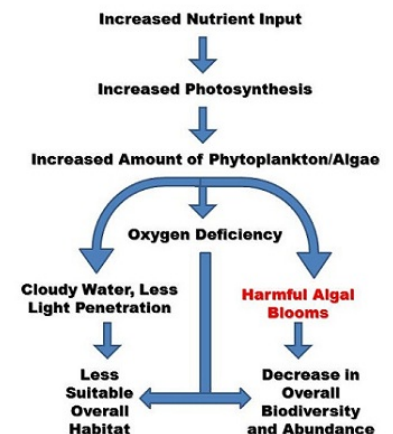
Important nutrients such as carbon, nitrogen, phosphorus, and water are cycled through living things and the environment through **biogeochemical cycles**. The following pictures are overviews of the carbon, phosphorus, and nitrogen cycles.



These natural processes are affected by human involvement. The table below shows how humans change the cycles:

Cycle Disturbance/problem	Ecosystem Effect
Hydrologic /deforestation and paving	↓ evapotranspiration, ↑ runoff, ↑ erosion, ↑ flooding
Carbon/fossil fuel combustion and deforestation	↑ CO_2 levels, ↑ atmospheric heat retention, ↑ global warming
Nitrogen/excess (fertilizers, pig farms)	↑ Atmospheric N_2 , change of diversity (eutrophication)
Phosphorus/excess (fertilizers, detergents, bird/bat guano)	Algal bloom, change of diversity

Eutrophication is a term that demonstrates how changing nutrient levels affect the organisms in an ecosystem. For eutrophication, and increase of nutrients (usually nitrogen and phosphorus because they are limiting nutrients) is added. This increases photosynthesis (sometimes called an **algal bloom** because the algae covers the top of the body of water), and as these producers die, the decomposers come in to feed off of them. These decomposers are going through respiration and lower the oxygen available to all organisms that can cause many to die.



Ecology

Please use the link below to guide you

<https://docs.google.com/file/d/0By3MFJ-zJlsYVGpfREtjaUNxZFU/edit>

1. Write down the levels of ecosystem organization from smallest to largest
2. _____ make their own food, while _____ eat other organisms for food.
3. When you move up an energy pyramid, the amount of available energy (circle one) ↑ ↓
4. What is the difference between a food chain and a food web?
5. What is the difference between abiotic and biotic factors?
6. Explain the following organisms interactions
 - a. Competition
 - b. Predation
 - c. Symbiosis
 - i. Mutualism
 - ii. Commensalism
 - iii. Parasitism
7. _____ species are those that are naturally found in a location, while _____ species are accidentally or purposefully introduced to a new area
8. Explain the difference between
 - a. Threatened
 - b. Endangered
 - c. Extinct
9. What is succession?

Constructed Response Questions

Subject	Environmental Science
Unit Name	Biomes
<p>Biomes are defined as the world's major communities have characteristic plants and animals, temperatures, rainfall, and climates.</p> <ul style="list-style-type: none"> Identify 5 biomes and describe their major characteristics. Which biome would you like to live in and why? Cite evidence. 	
<p>The tundra biome and desert biomes have been noted as being the most extreme.</p> <ul style="list-style-type: none"> Compare and contrast the characteristics plants, animals, temperatures, rainfall and climates of these two biomes. Which do you feel is the most extreme and why? 	
<p>Terrestrial biomes are biomes that are comprised of land.</p> <ul style="list-style-type: none"> Identify the terrestrial biomes and describe their environmental importance, characteristic biotic and abiotic components and threats to survival. What do you think would happen to each of these biomes if there was a significant amount of precipitation (i.e. rainfall, hurricanes, flooding, etc.) 	
<p>All biomes have a different level of biodiversity?</p> <ul style="list-style-type: none"> Identify which biome has the greatest level of biodiversity and describe factors that are endangering this biome? What do you feel is the most important resource that humans obtain from this biome? Explain. 	
<p>The survival of reefs is currently threatened.</p> <ul style="list-style-type: none"> Identify and describe the three types of reefs. What are factors that are contributing to their demise? What would happen if reefs became extinct? 	
<p>The major forest biomes include tropical rainforests, temperate rain forests, temperate deciduous forests, and taigas</p> <ul style="list-style-type: none"> What factors are currently threatening the stability and survival of forest biomes? If you were the governor of New Jersey, how would assist in the forest biome survival here in our state? 	

Constructed Response Questions

Subject	Environmental Science
Unit Name	Dynamic Earth
<p>Science is an organized way of gathering and analyzing evidence about the natural world.</p> <ul style="list-style-type: none"> • Why is it important to study environmental science? • How do we find explanations for events in the natural world? 	
<p>Experimentation is very important in studying scientific phenomenon.</p> <ul style="list-style-type: none"> • Explain the steps of the scientific method in detail. • Describe the parts of an experiment (control, dependent variable and independent variable) and give an example of each. 	
<p>Safety is vital in any scientific investigation.</p> <ul style="list-style-type: none"> • Discuss three safety measures that you feel are important and explain why. • Explain why proper disposal of biological/chemical waste is necessary. 	
<p>The four major systems of the Earth are the geosphere, hydrosphere, atmosphere, and biosphere.</p> <ul style="list-style-type: none"> • Describe each of these major systems. • What would happen if the atmosphere was to change composition? 	
<p>Peer-review is an accepted practice in scientific research.</p> <ul style="list-style-type: none"> • Describe the process of peer-review in detail. • Why is peer-review an important practice in science? 	
<p>The transfer of energy within the Earth influences geologic events on the surface (continental drift, plate tectonics and earthquakes)?</p> <ul style="list-style-type: none"> • What is the relationship between plate tectonics and Continental Drift? • What do you feel is the most significant geological event? Explain. 	
<p>Scientific evidence has shown that the Earth has changed over time.</p> <ul style="list-style-type: none"> • How and why have the Earth's tectonic plates changed over time? How do we know? • What evidence do you feel is most vital in describing the changes in the Earth? 	
<p>You are well acquainted with the negative effects of the greenhouse effect, but the fact remains that without it, Earth would be a very different place.</p> <ul style="list-style-type: none"> • Explain how the green house effect works. • How would our world be different if there were no such thing as the greenhouse effect? <p>Use specific details to support your answer!</p>	
<p>The term one world ocean is used to describe a majority of the hydrosphere.</p> <ul style="list-style-type: none"> • List two of the effects associated with the thermo-haline conveyor belt. • How might the world change if the conveyor belt were to cease? 	

Constructed Response Questions

Subject	Environmental Science
Unit Name	Ecosystems
<p>Rainforests are endangered biomes found in limited quantities throughout the world.</p> <ul style="list-style-type: none"> • Discuss two reasons for rainforest destruction. • Explain how we that do not live in countries with rainforests can help to protect them and why it is important that we do so. <p>Use specific details to support your answer!</p>	
<p>There are 5 levels of ecological study that describe the theme of interconnectedness through various forms of symbiosis.</p> <ul style="list-style-type: none"> • Identify and describe each of the five levels with examples. Be specific. • What would happen if predation was non-existent? 	
<p>Energy transfers through an ecosystem throughout different channels.</p> <ul style="list-style-type: none"> • Describe how energy transfers though an ecosystem, beginning with producers. • Give an example of each level of a food chain and describe what would happen if producers were removed from this chain? 	
<p>The carbon, nitrogen, oxygen and water cycle are important in all ecosystems.</p> <ul style="list-style-type: none"> • Describe each of these cycles. • Which cycle do you feel is most important and why? 	
<p>Global warming has received much publicity in recent years.</p> <ul style="list-style-type: none"> • Describe the contributors of global warming. • Do you agree with scientists' theories of the direction that the Earth in heading, with respect to global warming? Explain your reasoning. 	
<p>An energy pyramid illustrates how organisms obtain energy.</p> <ul style="list-style-type: none"> • Determine the energy levels within an energy pyramid and describe each. • What factor do you think will determine the number of trophic levels in an ecosystem and explain your reasoning? 	
<p>Acid precipitation is defined as any precipitation with a pH less than 5.6. Acid rain is known to have detrimental effects on the ecosystem.</p> <ul style="list-style-type: none"> • Delineate how acid rain forms. Be specific with chemical reactions and explanations of sources. • What would happen to an ecosystem if the pH of the precipitation rose significantly to a basic level? 	
<p>Symbiotic relationships involve the interaction of two species.</p> <ul style="list-style-type: none"> • List and describe the three types of symbiotic relationships found in nature. • If you had to choose one which one would you pick? Explain your choice. 	
<p>Biogeochemical cycles are necessary in returning needed nutrients to the soil/atmosphere.</p> <ul style="list-style-type: none"> • Give two examples of these cycles and cite the materials that are recycled. • Predict what would happen to life if one of these cycles stopped. 	

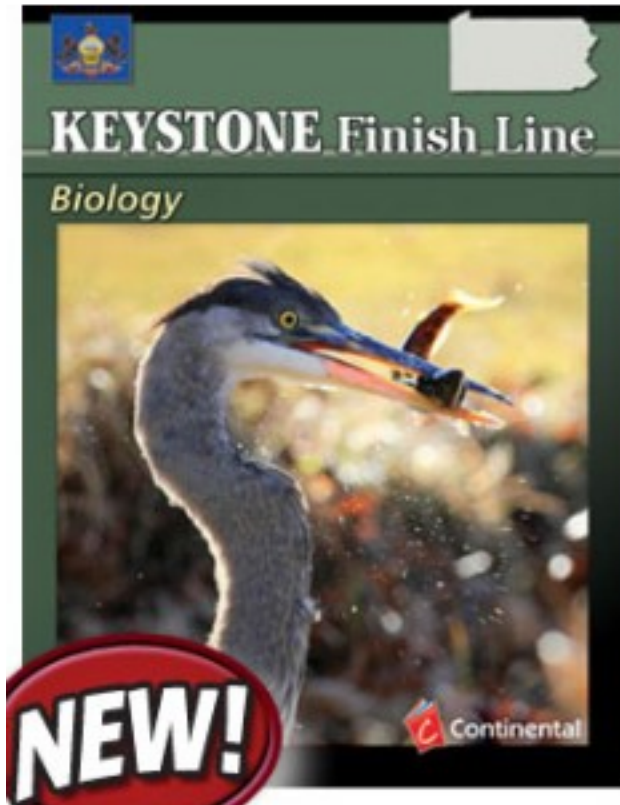
Constructed Response Questions

Subject	Environmental Science
Unit Name	Energy
<p>Our daily needs depend upon energy.</p> <ul style="list-style-type: none"> Define the Law of Conservation of Energy and cite with an example. What energy needs are you most dependent upon and why? 	
<p>Coal and oil are two forms of non-renewable sources of energy that our country depends upon.</p> <ul style="list-style-type: none"> Compare coal formation vs. oil formation. What would happen if the oil wells ran out of oil? 	
<p>Global warming is the gradual increase in the Earth's temperature.</p> <ul style="list-style-type: none"> Discuss the role of fossil fuels in global warming. What do you think are suitable energy resources that could replace fossil fuels? Be specific with details. 	
<p>Nuclear energy is both beneficial and potentially harmful to our lives as an energy source.</p> <ul style="list-style-type: none"> Give an example of how nuclear energy can be both beneficial and potentially harmful to us. Be specific and explain in detail. Do you feel the risks outweigh the benefits of nuclear energy or vice-versa. Explain. 	
<p>Nuclear, solar, wind, geothermal, and hydroelectric are alternative forms of energy.</p> <ul style="list-style-type: none"> Describe each of these forms of alternative energy. Which of these types of alternative energy do you feel is the most efficient? Explain. 	

Constructed Response Questions

Subject	Environmental Science
Unit Name	Pollution
<p>Landfills are storage areas for solid waste that are decreasing as the world's production of waste increase.</p> <ul style="list-style-type: none"> Describe the design of a landfill and the problems that are associated with it. What would happen if all of the landfills "filled up"? 	
<p>Pollution comes in many forms and is detrimental to the environment.</p> <ul style="list-style-type: none"> Define pollution and describe what constitutes a pollutant. How do you contribute to the world's pollution problem and what can you do to decrease the amount of pollution that you produce? 	
<p>Pollution is an unwanted environmental change caused by human activity.</p> <ul style="list-style-type: none"> Describe the six forms of pollution. Give detail and examples. Discuss how pollution affects both human health and the environment. 	
<p>Acid rain is defined as any form of precipitation with a pH less than 5.6.</p> <ul style="list-style-type: none"> Describe the effects that acid rain has on both biotic and abiotic factors. What would happen if the pH of a typically acidic environment were to increase to above 7.0? 	
<p>Water resources are in jeopardy of being depleted due to pollution.</p> <ul style="list-style-type: none"> Why are water resources important? 	

- How can you personally conserve the amount of water that you use?



LESSON 1: ECOSYSTEMS AND BIOMES	P 187 – 195
LESSON 2: ECOSYSTEMS INTERACTIONS	P 196 – 203
LESSON 3: CYCLES OF MATTER	P 204 – 210
LESSON 4: ECOSYSTEM RESPONSE TO CHANGE	P 211 – 226
 MODULE B REVIEW – CONTINUITY AND UNITY OF LIFE	 P 227 - 238

Keystone Pre-Test

The questions in this quiz refer to: Ecology

1. Where would a producer be found on a food chain?
a. the top b. the bottom c. the middle d. they would not be found on one
2. With an energy pyramid, how does the energy change as you go up the pyramid?
a. it decreases by 90% each level b. it decreases by different amounts each level
c. it increases by 90% each level d. it increases by different amounts each level
3. Which of the following would NOT be an abiotic factor?
a. amount of sunlight b. soil bacteria c. wind d. temperature
4. A fox chases, attacks, and kills a rabbit. What type of relationship would this be?
a. competition b. predation c. symbiosis d. parasitism
5. Two foxes try to kill the same rabbit. What type of relationship would this be?
a. competition b. predation c. symbiosis d. parasitism
6. The difference between environmental science and ecology is that environmental science includes ____, while ecology does not
a. bacteria b. plant c. animals d. people
7. All of the different species of microscopic organisms living in and on your body would be called a(n)
a. community b. ecosystem c. species d. population
8. Anything that would decrease the growth, existence, or distribution of one organism or a whole population would be called a(n)
a. eutrophic event b. pollutant c. stunting nutrient d. limiting factor
9. A species that belongs to an ecosystem is called ____, while a species that does not belong to an ecosystem is called ____.
a. threatened; endangered b. endangered; endemic c. endemic; non-native
d. non-native; endemic
10. A forest burns down after a lightning storm. The slow, gradual process of replacing the forest with different types of plants would be called
a. evolution b. succession c. development d. a tragedy

ECOLOGY GLOSSARY

- Abiotic:** *A term that describes a nonliving factor in an ecosystem.*
- Agriculture:** *The artificial cultivation of food, fiber, and other goods by the systematic growing and harvesting of various organisms.*
- Allele Frequency:** *The measure of the frequency of an allele at a genetic locus in a population; expressed as a proportion of percentage.*
- Aquatic:** *A term that describes an organism associated with a water environment.*
- Biogeochemical Cycles:** *The movement of abiotic factors between the living and nonliving components within ecosystems; also known as nutrient cycles (i.e., water cycle, oxygen cycle, and nitrogen cycle).*
- Biological Macromolecules:** *A group of biomacromolecules that interact with biological systems and their environments.*
- Biome:** *A large area or geographical region with distinct plant of animal groups adapted to that environment.*
- Biosphere:** *The zone of life on Earth; sum total of all ecosystems on Earth.*
- Biotic:** *A term that describes a living or once-living organism in an ecosystem.*
- Community (Ecological):** *Different populations of organisms interacting in a shared environment.*
- Competition:** *When individuals or groups of organisms compete for similar resources such as territory, mates, water, and food in the same environment.*
- Consumer (Ecological):** *An organism that obtains energy by feeding on other organisms or their remains.*
- Decomposer:** *An organism that obtains nutrients by consuming dead and decaying organic matter which allows nutrients to be accessible to other organisms.*
- Ecology:** *The study of the relationships between organisms and their interactions with the environment.*
- Ecosystem:** *A system composed of organisms and nonliving components of an environment.*
- Endemic Species:** *A species that is found in its originating location and is generally restricted to that geographic area.*
- Energy Pyramid:** *A model illustrates the biomass productivity at multiple trophic levels in a given ecosystem.*
- Environment:** *The total surroundings of an organism or a group of organisms.*
- Food Chain:** *A simplified path illustrating the passing of potential chemical energy (food) from one organism to another organism.*

- Food Web:** *A complex arrangement of interrelated food chains illustrating the flow of energy between interdependent organisms.*
- Habitat:** *An area that provides an organism with its basic needs for survival.*
- Isolating Mechanisms:** *Features of behaviors, morphology, or genetics which serve to prevent mating or breeding between two different species (e.g., temporal isolation- in which individuals are active at different times of the day, seasons, or mating periods; ecological isolation- in which individuals only mate in their specific habitat; behavioral isolation - when there are no sexual cues between representatives of the species; mechanical isolation - when there is no sperm transfer during an attempted mating; and gametic incompatibility - when there is sperm transfer without fertilization occurring).*
- If mating can take place, there are four factors that prevent hybrid viability: zygotic mortality (fertilization but no zygote), hybrid inviability (embryo is not viable), hybrid sterility (resulting adult is sterile), and hybrid breakdown (first generation is viable but future generations are not).*
- Limiting Factor:** *Chemical or physical factor that limits the existence, growth, abundance, or distribution of an individual organism or a population.*
- Nonnative Species:** *A species normally living outside a distribution range that has been introduced through either deliberate or accidental human activity; also can be known as introduced, invasive, alien, nonindigenous, or exotic.*
- Population:** *A group of individuals of the same species living in a specific geographical area and reproducing.*
- Population Dynamics:** *the study of short-and long-term changes in the number of individuals for a given population, as affected by birth, death, immigration, and emigration.*
- Producer (Ecological):** *An organism that uses a primary energy source to conduct photosynthesis or chemosynthesis.*
- Speciation:** *A process typically caused by the genetic isolation from a main population resulting in a new genetically distinct species.*
- Species:** *The lowest taxonomic level of biological classification consisting of organisms capable of reproduction that results in fertile offspring.*
- Succession:** *A series of predictable and orderly changes within an ecosystem over time.*
- Symbiotic Relationship:** *A relationship between two organisms (i.e., mutualism, in which both organisms benefit; parasitism, in which one organism benefits and the other organism is harmed; and commensalism, in which one organism benefits and the other organism does not benefit or is harmed).*
- System:** *A set of interacting or interdependent components, real or abstract, that form an integrated whole. An open system is able to interact with its environment. A closed system is isolated from its environment.*

Terrestrial: *A term that describes an organism associated with a land environment.*

Trophic Level: *The position of an organism in relation to the flow of energy and inorganic nutrients through an ecosystem (e.g., producer, consumer, and decomposer).*

Keystone Exam – Biology Review Packet

- 1.) Which characteristic is shared by **all** prokaryotes and eukaryotes?
- A. Ability to store hereditary information
 - B. Use of organelles to control cell processes
 - C. Use of cellular respiration for energy release
 - D. Ability to move in response to environmental stimuli
- 2.) Living organisms can be classified as prokaryotes or eukaryotes. Which two structures are common to both prokaryotic and eukaryotic cells?
- A. Cell wall and nucleus
 - B. Cell wall and chloroplast
 - C. C. plasma membrane and nucleus
 - D. D. plasma membrane and cytoplasm

- 3.) Prokaryotic cells are generally much smaller than eukaryotic cells.

Part A: Identify a structural difference between prokaryotic cells and eukaryotic cells that is directly related to their difference in size.

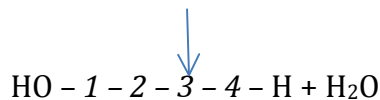
Part B: Based on structural difference, explain why prokaryotic cells can be much smaller than eukaryotic cells.

Part C: Describe one Similarity between prokaryotic cells and eukaryotic cells that is independent of size.

- 4.) Alveoli are microscopic air sacs in the lungs of mammals. Which statement **best** describes how the structure of the alveoli allows the lungs to function properly?
- A. They increase the amount of energy transferred from the lungs to the blood>
 - B. They increase the flexibility of the lungs as they expand during inhalation.
 - C. They increase the volume of the lungs, allowing more oxygen to be inhaled.
 - D. They increase the surface area of the lungs, allowing efficient gas exchange.

- 5.) Which statement **best** describes an effect of the low density of frozen water in a lake?
- When water freezes, it contracts, decreasing the water level in a lake.
 - Water in a lake freezes from the bottom up, killing most aquatic organisms.
 - When water in a lake freezes, it floats, providing insulation for organisms below.
 - Water removes thermal energy from the land around a lake, causing the lake to freeze.
- 6.) Which statement correctly describes how carbon's ability to form four bonds makes it uniquely suited to form macromolecules?
- It forms short, simple carbon chains.
 - It forms large, complex, diverse molecules.
 - It forms covalent bonds with other carbon atoms.
 - It forms covalent bonds that can exist in a single plane.

- 7.) Use the diagram below to answer the question.



The diagram shows a reaction that forms a polymer from two monomers.
 What is this type of reaction called?

- Glycolysis
 - Hydrolysis
 - Photosynthesis
 - Dehydration synthesis
- 8.) Carbohydrates and proteins are two types of macromolecules, which functional characteristic of proteins distinguishes them from carbohydrates?
- Large amount of stores information
 - Ability to catalyze biochemical reactions
 - Efficient storage of usable chemical energy
 - Tendency to make cell membranes hydrophobic.
- 9.) Proteins are a major part of every living cell and have many different functions within each cell. Carbohydrates also perform numerous roles in living things.

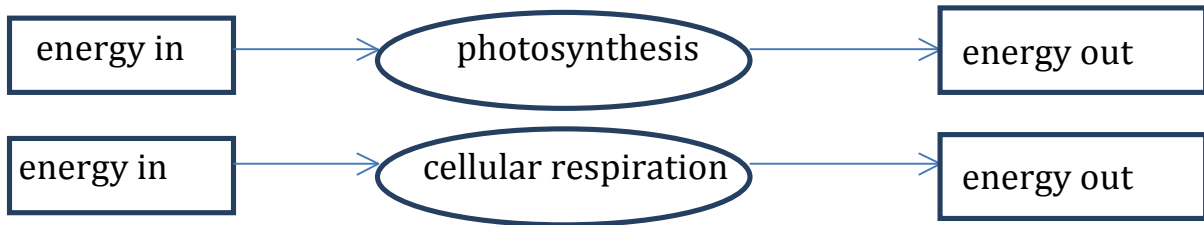
Part A: Describe the general composition of a protein molecule.

Part B: Describe how the structures of proteins differ from the structures of carbohydrates.

Part C: Describe how the functions of proteins differ from the functions of carbohydrates.

- 10.) Substance A is converted to substance B in a metabolic reaction. Which statement **best** describes the role of an enzyme during this reaction?
- A.) It adjusts the pH of the reaction medium.
 - B.) It provides energy to carry out the reaction.
 - C.) It dissolves substance A in the reaction medium.
 - D.) It speeds up the reaction without being consumed.
- 11.) A scientist observes that, when the pH of the environment surrounding an enzyme is changed, the rate the enzyme catalyzes a reaction greatly decreases. Which statement **best** describes how a change in pH can affect an enzyme?
- A.) A pH change can cause the enzyme to change its shape.
 - B.) A pH change can remove energy necessary to activate an enzyme.
 - C.) A pH change can add new molecules to the structure of the enzyme.
 - D.) A pH change can cause an enzyme to react with a different substrate.
- 12.) Using a microscope, a student observes a small, green organelle in a plant cell. Which energy transformation **most likely** occurs first within the observed organelle?
- A.) ATP to light
 - B.) light to chemical
 - C.) heat to electrical
 - D.) chemical to chemical
- 13.) Photosynthesis and cellular respiration are two major processes of carbon cycling in living organisms. Which statement correctly describes one similarity between photosynthesis and cellular respiration?
- A.) Both occur in animal and plant cells.
 - B.) Both include reactions that transform energy.
 - C.) Both convert light energy into chemical energy.
 - D.) Both synthesize organic molecules as end products.
- 14.) A protein in a cell membrane changed its shape to move sodium and potassium ions against their concentration gradients. Which molecule was **most likely** used by the protein as an energy source?
- A.) ATP
 - B.) ADP
 - C.) catalase
 - D.) amylase

15.) Use the diagrams below to answer the question.



Part A: Complete the chart below by describing energy transformations involved in each process.

Process	Energy Transformations
photosynthesis	
cellular respiration	

Part B : Describe how energy transformations involved in photosynthesis are related to energy transformations involved in cellular respiration.

16.) Carbon dioxide and oxygen are molecules that can move freely across a plasma membrane. What determines the direction that carbon dioxide and oxygen molecules move?

- A.) Orientation of cholesterol in the plasma membrane.
- B.) Concentration gradient across the plasma membrane.
- C.) Configuration of phospholipids in the plasma membrane.
- D.) Location of receptors on the surface of the plasma membrane.

17.) A sodium-potassium pump within a cell membrane requires energy to move sodium and potassium ions

into or out of a cell. The movement of glucose into or out of a cell does not require energy. Which statement **best** describes the movement of these materials across a cell membrane?

- A.) Sodium and potassium ions move by active transport, and glucose moves by osmosis.
- B.) Sodium and potassium ions move by active transport, and glucose moves by facilitated diffusion.

- C.) Sodium and potassium ions move by facilitated diffusion, and glucose moves by osmosis.
D.) Sodium and potassium ions move by facilitated diffusion, and glucose moves by active transport.

18.) Some animals can produce a potassium ion concentration inside their cells that is twenty times greater than that of their environment. This ion concentration gradient is maintained by the plasma membrane.

Part A: Identify the process in the cell membrane that produces this difference in concentration.

Part B: Explain the process that occurs as the cell produces the ion concentration gradient.

Part C: Compare the process of potassium ion transport to another mechanism that moves material across the plasma membrane.

19.) The rough endoplasmic reticulum and Golgi apparatus work together in eukaryotic cells. What is one way that the rough endoplasmic reticulum assists the Golgi apparatus?

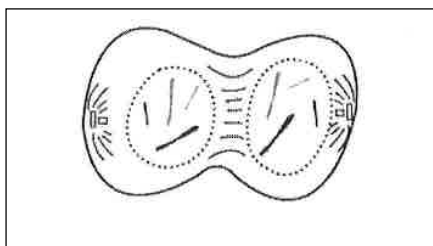
- A.) It assembles nucleic acids from monomers.
B.) It breaks down old damaged macromolecules.
C.) It packages new protein molecules into vesicles.
D.) It determines which protein molecules to synthesize.

20.) Which example is an activity that a fish **most likely** uses to maintain homeostasis within its body?

- A.) Using camouflage to avoid predators.
B.) Feeding at night to regulate body temperature.
C.) Moving to deeper water to regulate metabolic wastes.
D.) Exchanging gases through its gills to regulate oxygen levels.

21.) Use the illustration below to answer the question.

Cell Division



Which statement **best** describes the phase of the cell cycle shown?

- A.) The cell is in prophase of mitosis because the number of chromosomes has doubled.
- B.) The cell is in prophase I of meiosis because the number of chromosomes has doubled.
- C.) The cell is in telophase of mitosis because the cell is separating and contains two copies of each chromosome.
- D.) The cell is in telophase of meiosis because the cell is separating and contains two copies of each chromosome.

22.) Mitosis and meiosis are processes by which animal and plant cells divide. Which statement **best** describes a difference between mitosis and meiosis?

- A.) Meiosis is a multi-step process.
- B.) Mitosis occurs only in eukaryotic cells.
- C.) Meiosis is used in the repair of an organism.
- D.) Mitosis produces genetically identical daughter cells.

23.) Patau syndrome can be a lethal genetic disorder in mammals, resulting from chromosomes failing to separate during meiosis.

Part A: Identify the step during the process of meiosis when chromosomes would **most likely** fail to separate.

Part B: Describe how chromosome separation in meiosis is different from chromosome separation in mitosis.

Part C: Compare the effects of a disorder caused by chromosomes failing to separate during meiosis, such as Patau syndrome, to the effects of chromosomes failing to separate during mitosis.

24.) Which process helps to preserve the genetic information stored in DNA during DNA replication?

- A.) The replacement of nitrogen base thymine with uracil.
- B.) Enzymes quickly linking nitrogen bases with hydrogen bonds.
- C.) The synthesis of unique sugar and phosphate molecules for each nucleotide
- D.) Nucleotides lining up along the template strand according to base pairing rules.

25.) In a flowering plant species, red flower color is dominant over white flower color. What is the genotype of any red-flowering plant resulting from this species?

- A.) Red and white alleles present on one chromosome.
- B.) Red and white alleles present on two chromosomes.
- C.) A red allele present on both homologous chromosomes.
- D.) A red allele present on at least one of two homologous chromosomes.

26.) Use the table below to answer the question.

Blood Types

Genotype(s)	Phenotype
ii	O
I ^A I ^A , I ^A i	A
I ^B I ^B , I ^B i	B
I ^A I ^B	AB

Blood type is inherited through multiple alleles, including I^A, I^B, and i. A child has type A blood. If the father has type AB blood, what are all the possible phenotypes of the mother?

- A.) Phenotypes O or A.
- B.) Phenotypes A or AB.
- C.) Phenotypes A, B, AB.
- D.) Phenotypes O, A, B, AB.

27.) A cattle farmer genetically crosses a cow (female) with a white coat with a bull (male) with a red coat. The resulting calf (offspring) is roan, which means there are red and white hairs intermixed in the coat of the calf. The genes for coat color in cattle are co-dominant.

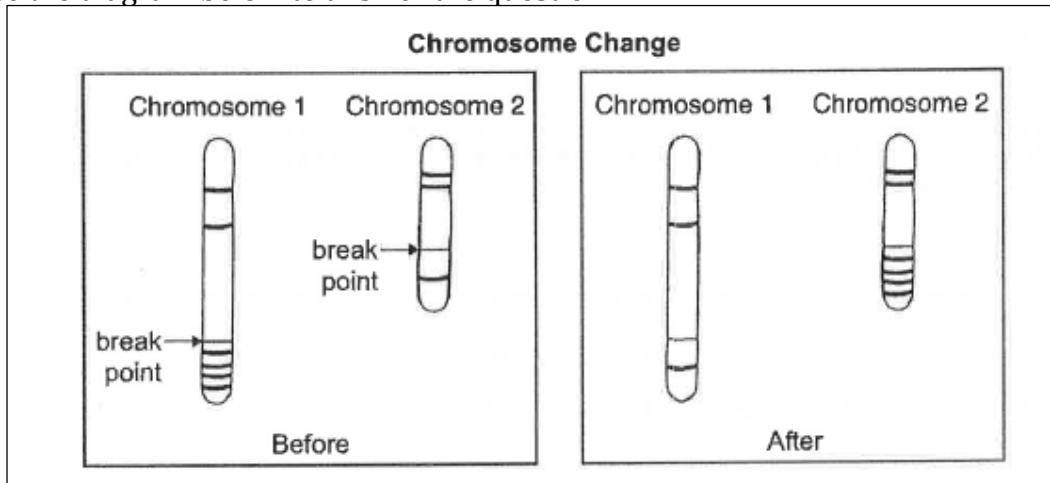
Part A: Although a farm has cattle in all three colors, the farmer prefers roan cattle over white or red cattle. Use the Punnett square to show a cross that would produce only roan offspring.

	_____	_____

Part B: Explain how a roan calf results from one white-and one red-coated parent. In your explanation, use letters to represent genes. Be sure to indicate what colors the letters represent.

Part C: Predict the possible genotypes and phenotypes of the offspring produced from two roan cattle.

28.) Use the diagram below to answer the question.



Which type of change in chromosome composition is illustrated in the diagram?

- A.) deletion
- B.) insertion
- C.) inversion
- D.) translocation

29.) Which statement describes a cell process that is common to both eukaryotic and prokaryotic cells?

- A.) Both cell types carry out transcription in the nucleus.
- B.) Both cell types use ribosomes to carry out translation.
- C.) Both cell types assemble amino acids to carry out transcription.
- D.) Both cell types carry out translation in the endoplasmic reticulum.

30.) The endoplasmic reticulum is a network of membranes within the cell, and it is often classified as rough or smooth, depending on whether there are ribosomes on its surface. Which statement **best** describes the role of rough endoplasmic reticulum in the cell?

- A.) It stores all proteins for later use.
- B.) It provides an attachment site for larger organelles.
- C.) It aids in the production of membrane and secretory proteins.
- D.) It stores amino acids required for the production of all proteins.

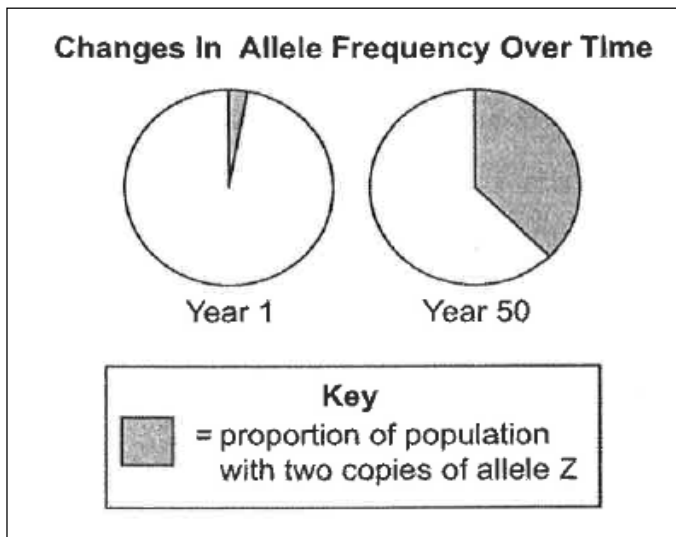
31.) A genetic mutation resulted in a change in the sequence of amino acids of a protein, but the function of the protein was not changed. Which statement **best** describes the genetic mutation?

- A.) It was a silent mutation that caused a change in the DNA of the organism.
- B.) It was a silent mutation that caused a change in the phenotype of the organism.
- C.) It was a nonsense mutation that caused a change in the DNA of the organism.
- D.) It was a nonsense mutation that caused a change in the phenotype of the organism.

32.) Genetic engineering has led to genetically modified plants that resist insect and bacterial and fungal infections. Which outcome would **most likely** be a reason why some scientists recommend caution in planting genetically modified plants?

- A.) unplanned ecosystem interactions
- B.) reduced pesticide and herbicide use
- C.) improved agricultural yield and profit
- D.) increased genetic variation and diversity

33.) Use the circle graphs below to answer the question.



The graphs illustrate change in a lizard population over time. Which process **most likely** led to the change in the lizard population?

- A.) natural selection for a trait that is beneficial to lizards
- B.) natural selection against a trait that is beneficial to lizards
- C.) artificial selection for a trait that is beneficial to lizards
- D.) artificial selection against a trait that is beneficial to lizards

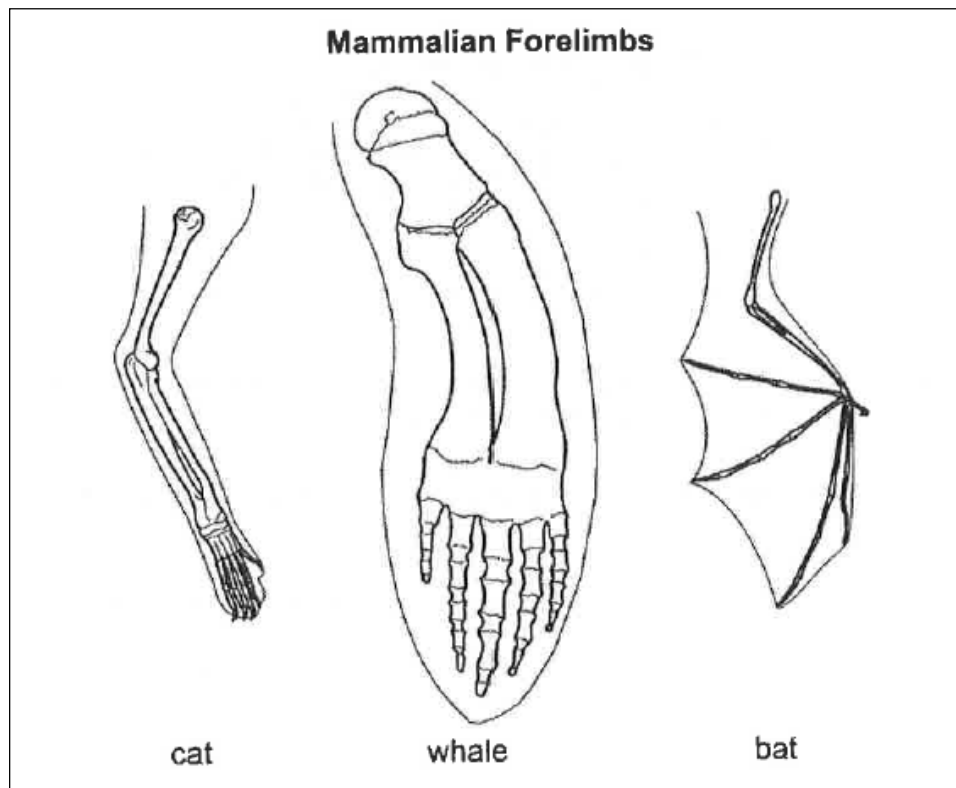
34.) In North America, the eastern spotted skunk mates in late winter, and the western spotted skunk mates in late summer. Even though their geographic ranges overlap, the species do not mate with each other. What **most likely** prevents these two species from interbreeding?

- A.) habitat isolation
- B.) gametic isolation
- C.) geographic isolation
- D.) reproductive isolation

35.) A mutation occurs in the genes that code for coat color in deer. Which change will **most likely** result from this mutation?

- A.) A change in the selection pressures acting on coat color.
- B.) A change in the coat-color genes of deer predator species.
- C.) An increase in coat-color diversity in the population.
- D.) an increase in the number of genes for coat color in the population.

36.) Use the illustration below to answer the question.



The skeletons of mammalian forelimbs represent variations of a structure that was present in their common ancestor. What has **most likely** caused the variation in forelimbs?

- A.) changes in muscle structure
- B.) changes in the genetic codes
- C.) trait formation due to behaviors
- D.) development of vestigial structures

37.) Use the table below to answer the question.

Sequence Differences between COII Genes in Some Animals	
Animal	Number of Base Differences from a Rat
mouse	101
cow	136

The gene COII is the genome of many organisms. A comparison of the number of base differences between the COII gene in a rat and that of two other animals is shown.

Part A: Based on the data, describe a possible evolutionary relationship between rats, mice and cows.

Part B: Describe how different organisms having a common gene, such as COII, supports the theory of evolution.

Part C: The COII gene of a monkey has 203 base differences from the same gene in a rat and 210 base differences from the same gene in a mouse. Compare the evolutionary relationships between the monkey, the rat and the mouse.

38.) Use the table below to answer the question.

Student's Observations of a Pond Ecosystem	
Quantitative	Qualitative
37 fish and 3 frogs	Leaves lie on the bottom of the pond.
2 types of aquatic grass	Water insects move along the water's surface.
12 small rocks and 1 medium rock	All 3 frogs are sitting on a pond bank.
sand	

A group of students measured a ten-square-meter section of a pond ecosystem and recorded observations. Which statement is a testable hypothesis?

- A.) The frogs living in the pond represent a population.
- B.) Water is an abiotic component in the pond ecosystem.
- C.) If the fish are given more food, then they will be happier.
- D.) If the frogs are startled, then they will jump into the water.

39.) Use the list below to answer the question.

Observations

- Two grey wolves
- five moose
- several species of conifer trees
- large granite rock
- shallow pond

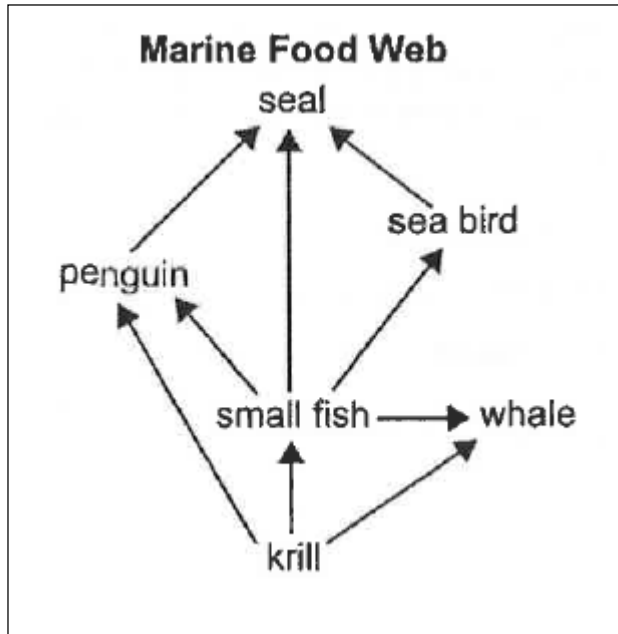
A student wrote several observations in a field notebook. Which term **best** classifies all of the student's observations?

- A.) population
- B.) food chain
- C.) ecosystem
- D.) community

40.) A researcher observing an ecosystem describes the amount of sunlight, precipitation, and type of soil present. Which factors is the researcher **most likely** describing?

- A.) biotic factors in a forest
- B.) biotic factors in a tundra
- C.) abiotic factors in a prairie
- D.) abiotic factors in an ocean

41.) Use the diagram below to answer the question.



Which sequence correctly describes the flow of energy between organisms in the marine food web?

- A.) from seals to penguins to krill
- B.) from whales to drill to small fish
- C.) from sea birds to seals to penguins
- D.) from small fish to penguins to seals

42.) A species of snapping turtles has a tongue that resembles a worm. The tongue is used to attract small fish. Which **best** describes the interaction between the fish and the snapping turtle?

- A.) predation
- B.) symbiosis
- C.) parasitism
- D.) competition

43.) Which statement correctly describes how nitrogen in the soil returns to the atmosphere?

- A.) Soil bacteria convert into nitrogen gas.
- B.) Decomposers directly convert ammonium into nitrogen gas.
- C.) Plants assimilate nitrites and convert them into nitrogen gas.
- D.) Nitrogen-fixing bacteria in plant roots convert nitrates into nitrogen gas.

44.) Agricultural runoff can carry fertilizers into lakes and streams. This runoff can cause algae populations to increase. Which effect does this change in the algae population sizes **most likely**

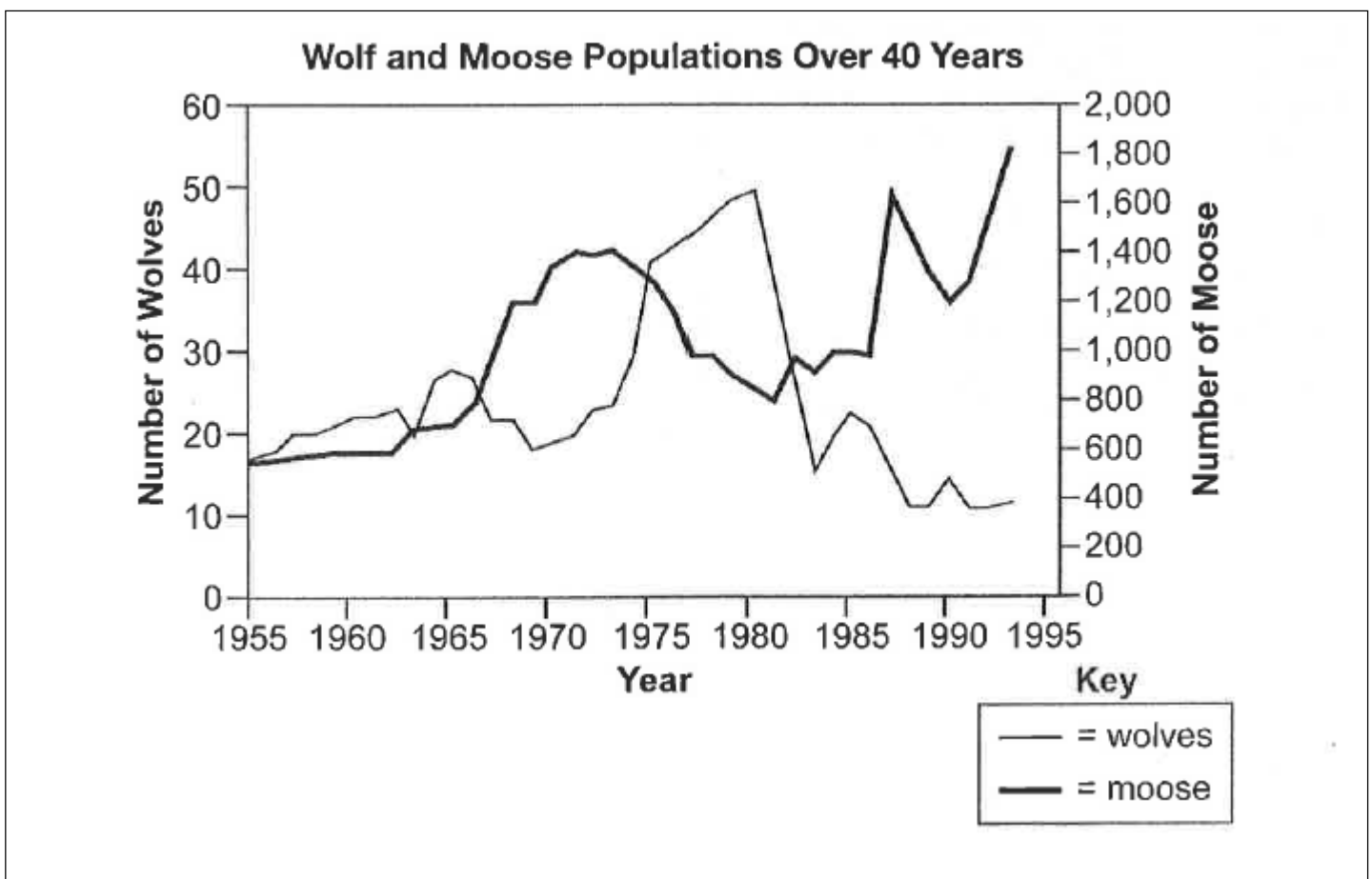
have on affected lakes and streams?

- A.) an increase in water level
- B.) an increase in water clarity
- C.) a reduction in dissolved oxygen needed by fish and shellfish
- D.) a reduction in temperature variations near the water's surface

45.) A farmer observed that an increase in a field's soil nitrogen content was followed by an increase in producer productivity. What does this observation **most likely** indicate about the relationship between nitrogen and the producers in the field?

- A.) Nitrogen was a biotic factor.
- B.) Nitrogen was a limiting factor.
- C.) Nitrogen became a surplus resource.
- D.) Nitrogen became a selection pressure.

46.) Use the graph below to answer the question.



Isle Royale is located in Lake Superior. Isle Royale is home to populations of wolves and moose. The interactions between the wolves and moose, as well as the individual population sizes, have been studied since 1958. The graph shows the population sizes over time for both wolves and moose.

Part A: Describe one limiting factor for the moose population.

Part B: Explain one likely reason why the wolf population rapidly increased between 1975 and 1980.

STUDY ISLAND – KEYSTONE BIOLOGY

- 1 Pretest Pretest - Biology**
- 2 Science as Inquiry**
 - a. Nature of Science - lesson Flash Cards**
 - b. Scientific Inquiry - lesson**
- 3 Cells and Cell Processes - The Chemical Basis for Life**
 - a. Organic Molecules & Water – lesson Flash Cards**
 - b. Enzymes - lesson Flash Cards Virtual Lab Activity**
- 4 Cells and Cell Processes - Basic Biological Principles**
 - a. Cell Structure & Organization - lesson Flash Cards Virtual Lab Activity**
- 5 Cells and Cell Processes - Homeostasis, Transport, and Bioenergetics**
 - a. Homeostasis & Transport – lesson Flash Cards Virtual Lab Activity**
 - b. Cellular Energy - lesson Flash Cards Virtual Lab Activity**
- 6 Continuity and Unity of Life - Cell Growth and Reproduction and Genetics**
 - a. Cell Growth & Reproduction - lesson Flash Cards**
 - b. DNA & Genetics - lesson Flash Cards**
 - c. Heredity - lesson Flash Cards**
 - d. Mutations & Genetic Variability - lesson Flash Cards**
 - e. Biotechnology - lesson**
- 7 Continuity and Unity of Life - Theory of Evolution**
 - a. Theory of Evolution - lesson Flash Cards**
 - b. Mechanisms of Evolution - lesson Flash Cards**
- 8 Continuity and Unity of Life - Ecology**
 - a. Ecosystems & Biomes - lesson Flash Cards**
 - b. Energy Flow in Ecosystems - lesson Flash Cards**
 - c. Organism Interactions & Population Dynamics lesson Flash Cards Virtual Lab Activity**
 - d. Earth's Cycles - lesson Flash Cards**
 - e. Environmental Change - lesson**
- 9 Post Test Post Test - Biology**

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Exploratorium a twenty-first-century learning laboratory

<http://www.exploratorium.edu/>

Climate Change: Basic Information

<http://www.epa.gov/climatechange/basics/>

Virtual Cell Animation Collection

<http://vcell.ndsu.nodak.edu/animations/>

PBS Learning Media

<http://www.pbslearningmedia.org/>

A Plus

www.wba.aplusanywhere.com/westphiladelphia/

Biology Animation Gallery

<http://www.sumanasinc.com/webcontent/animation.html>

Glucose Metabolism in Eukaryotic Cell

http://www.uic.edu/classes/bios/bios100/lectures/resp_summary.html

Peters Township Biology Resources

<http://www.ptsd.k12.pa.us/BiologyKeystone.aspx>

Neptune High School Science Department

<http://www.neptune.k12.nj.us/site/Default.aspx?PageID=716>

YouTube Playlist - Biology Videos

<http://www.youtube.com/playlist?list=PL7A750281106CD067&feature=plcp>

Biology Simulations

<http://phet.colorado.edu/en/simulations/category/biology>

McGraw-Hill Biology Animations

<http://highered.mcgraw-hill.com/sites/dl/free/0072437316/120060/ravenanimation.html>

LearnersTV Biology Animations

<http://www.learnerstv.com/animation/animationcategory.php?cat=biology>

Bio Alive – Life Science Video Share

<http://bio-alive.com/animations/biology.htm>

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